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TABLE OF CONTENTS.

PAGE

List of Authors and Contributors 9
Officers of the Institute 11
Corresponding Members of Council 12
Basis of Constitution and Objects of the Institute 13
Annual Report for 1884–5 and Balance Sheet 17, 22
Address by Alfred Carpenter, M.D., C.S.S.CAM. 23
The Water Supply of Ancient Roman Cities, by Prof. W. H. Corfield, M.A., M.D. 31
Places at which the Congresses have been held 40

CONGRESS AT LEICESTER.

Introduction 44
Names of Presidents, Presidents of Sections, &c. 46
List of Judges of the Exhibition 48
Address by Prof. F. S. B. F. de Chaumont, M.D., F.R.S. 49

SECTION I.

SANITARY SCIENCE AND PREVENTIVE MEDICINE.

Address by Arthur Ransome, M.A., M.D., L.S.A., F.R.S., President of the Section 73
Infantile Diarrhœa, by W. E. Buck, M.D. 86
Vaccination *versus* Isolation as a preventive of outbreaks of Small Pox, by Surgeon-Major R. Pringle, M.D. 99
Impediments to Sanitary Progress, by Lewis Angell, M.INST.C.E. . 117
Sanitary Reform and Voluntary effort, by F. Scott 123
Sanitary House Management, by The Countess de Viesca 128
Ambulance Work, by J. H. Buckley 140

SECTION II.

ENGINEERING AND ARCHITECTURE.

Address by Percival Gordon Smith, F.R.I.B.A., President of the Section . 146
History of Sewerage and Sewage Treatment, Leicester, by John Underwood 164
Drainage of Continental Towns, by J. Gordon, M.INST.C.E. 181
Circular Hospital Wards, by H. Saxon Snell, F.R.I.B.A. 205
Smoke Abatement, by W. R. E. Coles 218
Ventilation of Chemical Laboratories and Science Schools generally, by E. C. Robins, F.S.A., F.R.I.B.A. 228
Plumbing and Plumbers' Work, by F. Scott 241

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

PAGE

Address by William Marcet, M.D., F.R.MET.SOC., F.C.S., F.R.S., President of the Section 246
The Valley of the Soar, by John D. Paul, F.G.S. 261
On a recent legal decision of importance in connection with water supply from wells, by W. Whitaker, B.A., F.G.S. 268
Hygienic Analysis, by Charles E. Cassal, F.C.S., F.I.C. 272
The use of Sodium Aluminate for Softening and Purifying Sewage and Waste Water from Factories, by F. Maxwell Lyte, F.C.S., F.I.C. . 280
The Danger to Health arising from Burial in Imperishable Coffins, by Rev. F. Lawrence 282

LECTURES DURING THE CONGRESS.

The Essentials of Local Government Reform, by Ernest Hart, Chairman National Health Society 287
Prevention better than Cure, by Captain Douglas Galton, R.E., C.B., D.C.L., F.R.S. 347
Closing Meeting and Report of Secretaries of Sections 367

REPORT OF THE JUDGES.

List of Medals and Certificates awarded at Leicester Exhibition . 371, 379

APPENDIX.

Regulations relating to the Examinations for Local Surveyors and Inspectors of Nuisances 385
Persons certificated by the Institute in 1885 388
Exhibitions held by the Institute 391
Classified List of Medals and Certificates awarded at the Exhibitions 392, 401
Alphabetical List of Medals and Certificates awarded at the Exhibitions. 417, 424
Addresses and Papers read before the Institute in 1885 438
List of books received during 1885 439
List of Fellows, Members, Associates, and Subscribers elected in 1885 . 443
Index of Plates 445
General Index 447

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Sanitary Institute of Great Britain.

Formation of the Institute.

The increasing importance attached to Sanitary Science and the recognised position it was assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health. In furtherance of the object, a meeting was held at St. James's Hall, on the 13th of July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved:—

First—"That in the opinion of this meeting the sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health' a Society be now formed, to be styled 'The Sanitary Institute of Great Britain.'"

Second—"That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution and of reporting to an adjourned public meeting to be held during the second week in October next."*

The Committee appointed to report upon the subject considered it would add greatly to the usefulness of the Institute if Mayors of Boroughs, Chairmen of Local Boards, Sanitary Authorities, Medical Officers of Health, and all who have to administer the Public Health Acts, would associate themselves with the Institute, either in their individual or corporate capacity, and take part in its proceedings. By thus bringing their united knowledge and experience to bear upon Sanitary matters, the laws relating to the same would become better known and be more efficiently administered.

Basis of the Constitution of the Institute.

Section I.

Charter of Incorporation, Membership, and Government of the Institute.

As soon as practicable a Charter of Incorporation shall be obtained, as it will facilitate some portions of the work of the Institute, more especially the examinations as set forth in Section II. Until a Charter

* An adjourned public meeting was held on the 14th of March, 1877, when the report was unanimously adopted and a Council subsequently appointed to carry it into effect.

is obtained, the examinations shall be continued as heretofore, and a Register of persons certificated as competent to act as Local Surveyors and Inspectors of Nuisances shall be formed.

The Institute shall consist of Fellows, Members, Associates, and Subscribers.

Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators, and others, who have done noteworthy Sanitary work.

Fellows are only elected from among the Members, and they must have been Members for at least one year before they are eligible for election as Fellows.

All Fellows shall pay a fee of Ten Guineas on taking up the Fellowship, and such fee shall entitle the Fellow to all the privileges and advantages of the Institute for life without further payment.

Any person proposed by three Fellows or Members, shall be eligible for election as a Member of the Institute.

Members shall be elected by ballot by the Council, and shall be eligible to serve on the Council, and to vote at all Elections and Meetings of the Institute. The admission Fee payable by a Member shall be Three Guineas, and the Annual Subscription Two Guineas.

Medical Officers of Health and Medical Men holding Certificates in Sanitary Science from any University or Medical Corporation shall be entitled to be enrolled as Members of the Institute without Admission Fee.

Members desirous of becoming Life Members may do so on payment of Ten Guineas in lieu of the Annual Subscription.

All persons who have passed the Examination and received the Certificate for Local Surveyor from the Institute, shall, by virtue of having so passed, become Members of the Institute upon the payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Any one proposed by two persons, either Fellows, Members, or Associates of the Institute, shall be eligible to be elected as an Associate of the Institute, the election to be by ballot by the Council. The Admission Fee payable by Associates shall be Two Guineas, and the Annual Subscription One Guinea.

All persons who have passed the Examination and received the Certificate for Inspector of Nuisances from the Institute, shall, by virtue of having so passed, become Associates of the Institute upon the payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Persons of either sex, interested in the advancement of Sanitary Science, shall be entitled to be enrolled as subscribers on payment of One Guinea annually.

Donors of Ten Guineas and upwards shall be entitled to be enrolled as "Life Subscribers," with all the privileges and advantages of Annual Subscribers without further payment.

Fellows, Members, Associates, and Subscribers shall be entitled to attend and to take part in the discussions at all meetings and Congresses of the Institute, and shall have free admission to any

Conversazione given by the Institute and Exhibitions of Sanitary Appliances held in connection with the Institute as long as they continue to pay their Subscription.

Holders of Half-Guinea Congress Tickets are entitled to the use of the Reception Room in the town of meeting, to admission to the Presidential and other Addresses, to all the Meetings, to the Exhibition of the Institute, and to any Conversazione given by the Institute.

The Institute shall be governed by a President, Vice-Presidents, and a Council of Twenty-four, consisting of Fellows and Members of the Institute, of whom not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year.

The first President of the Institute shall be His Grace the Duke of Northumberland. Future Presidents and Vice-Presidents shall be elected by the Council. The Council shall have the power of electing Honorary Members of the Institute, Honorary Foreign Associates, and Corresponding Members of the Council.

Section II.

Objects of the Institute.

To devote itself to the advancement of Sanitary Science and the diffusion of knowledge relating thereto.

To examine and to grant Certificates of Competence to Local Surveyors and Inspectors of Nuisances, and to persons desirous of becoming such or of obtaining the Certificate. The Examinations shall be held at such times and in such places as the Council may direct.

A Board of Examiners shall be appointed by the Council; such Board shall consist of gentlemen representing Medical, Chemical, and Sanitary Science, Engineering, Architecture, and Sanitary Jurisprudence.

The Examination for Local Surveyors shall include a competent knowledge of the Statute relating to Sanitary Authorities, of Sanitary Science and Construction, and of Engineering.

The Examination for Inspectors of Nuisances shall comprise the elements of Sanitary Science, together with Sanitary Construction and the Statutes relating to the prevention of disease and the suppression of nuisances injurious to health.

Fees shall be charged for the Examinations, and a Certificate of Competence, signed by the Examiners, shall be granted to successful candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

A Congress shall be held by the Institute for the consideration of subjects relating to Hygiene at such times and places as the Council may direct.

Exhibitions of Sanitary Apparatus and Appliances shall be held from time to time as the Council may direct.

Fellows, Members, Associates, and Subscribers shall have the right of Free Admission to the Exhibitions of the Institute whenever they are open. All fees payable by Exhibitors and the Public shall be fixed by the Council and belong to the Institute.

A Catalogue shall be published under the direction of the Council as a permanent record of the Exhibitions.

The Institute shall take such steps as may be within its power to obtain a complete registration of sickness, especially of preventable diseases.

The Institute shall endeavour to secure the services of medical men and others specially qualified to give lectures on subjects relating to the prevention and spread of disease.

The Institute shall encourage the formation of classes for technical instruction in Sanitary Science in such a way as may seem advisable to the Council.

A Library shall be formed in connection with the Institute.

ANNUAL REPORT OF THE COUNCIL

FOR 1884–5.

SINCE the establishment of the Institute in 1876, Sanitary Science has been making steady and, latterly, rapid strides; and is now generally recognized as one of the most important subjects of the day. The Council cannot but feel that this is in a measure due to the efforts made by the Sanitary Institute and kindred societies to awaken public interest, and diffuse Sanitary knowledge throughout the country. The gigantic scale of the International Health Exhibition last year is a standing proof of the rapid progress of this comparatively new science.

This is the Eighth Report that the Council have had the pleasure of laying before the members, and it is with much satisfaction they note that the Institute is keeping pace with the Science which it is, and has been, so instrumental in promoting.

A comparison of the cash statement with the similar ones made in previous years, shows a very considerable increase in the regular income of the Institute from Fees and Subscriptions. The expenditure, although necessarily increasing with the growth of the Institute, has not increased in the same proportion, and the Council have consequently been able to make a vote towards the completion of the valuable experiments which are being carried out by the Cowl Committee. These experiments will be referred to in a subsequent portion of the Report. The large expense connected with the Examinations is partly due to the issue of Circulars to the Local Sanitary Authorities.

The Congress was held in Dublin, and it is worthy of note that in two consecutive years the meetings of the Institute have been held, the one in the largest commercial city of Scotland, and the other in the capital of Ireland.

The invitation to Dublin was forwarded by Lord Brabazon, and signed by representatives of all the leading Societies, and by most of the prominent and influential residents in the city.

The Congress commenced on September 30th, and was presided over by Sir Robert Rawlinson, C.B. An account of the meetings, with the various papers and discussions, will be published in Volume VI. of the Transactions of the Institute.

His Excellency Earl Spencer, K.G., Lord Lieutenant of Ireland, honoured the Annual Dinner by his presence, and the Countess Spencer showed her interest in the proceedings by attending one of the Sectional meetings.

Interesting Excursions were made at the close of the business of the Congress.

Very spacious and well-arranged premises were provided at Balls Bridge for the Exhibition, and although its distance from the city made it necessary to provide special attractions, the number of visitors was considerably larger than at any other Exhibition of the Institute, 35,000 persons passing the turnstiles during the nineteen days it was open. There were 134 Exhibitors and 900 Exhibits. The Judges awarded 1 Silver Medal presented by the Exeter Gas Company, 13 Bronze Medals, 11 Special Certificates, and 64 Certificates—the Special Certificates being awarded to articles which had received Medals at previous Exhibitions of the Institute. 39 Exhibits were deferred for further practical trial and testing; the result of these trials will be reported at the Anniversary Meeting in July, when all the Medals and Certificates will be presented. The proceeds of one evening, for which a special Fête was arranged, were devoted to the Dublin Hospitals; the total amount raised being £430.

During the past year the Examinations have shown even more rapid increase than other sections of the Institute, and the Council are encouraged to find that this work is bearing good fruit. The number of candidates presenting themselves for Examination was more than double the number in any previous year.

The Examinations have been brought more prominently into notice

by a Circular signed by Lord Fortescue, and sent to nearly 2,000 Local Authorities through England, Scotland, and Ireland, calling their attention to the value of the Certificate granted at the Examination, as a reliable guide to local authorities in the selection of candidates.

The Examinations were held in June and November. In June, 23 candidates presented themselves; 6 for Certificates as Local Surveyors, and 17 for Certificates as Inspectors of Nuisances. 4 candidates were certificated as competent to discharge the duties of Local Surveyors, and 15 as competent to discharge those of Inspectors of Nuisances. At the Examination in November, 27 candidates presented themselves; 8 for Local Surveyors, and 19 for Inspectors of Nuisances. 3 candidates were certificated as competent to discharge the duties of Local Surveyors, and 12 as competent to discharge those of Inspectors of Nuisances.

The feasibility of some co-operation with the Association of Public Sanitary Inspectors, with a view of practically enlisting the interests of that Association with the work of the Examinations, is being carefully considered by the Council.

It is with much regret that the Council have to report the death of Dr. W. J. Collins, who was among the first Members of the Institute, having joined at its commencement, in 1876.

Since the last Annual Meeting there have been elected 5 Fellows, 18 Members, 5 Associates, and 2 Subscribers. The numbers on the roll of the Institute were, at the end of 1884, 95 Fellows, 204 Members, 37 Associates, 19 Subscribers, and 30 Honorary Foreign Associates: total, 385.

The retiring members of Council are Dr. G. D'Arcy Adams; Dr. T. W. Grimshaw; Dr. Charles Kelly; Rowland Plumbe, F.R.I.B.A.; E. C. Robins, F.S.A.; Edward Vigers, A.R.I.B.A. The following gentlemen are nominated for election at the Annual Meeting to fill the vacancies thus created:—A. Wynter Blyth, M.R.C.S.; Dr. T. Orme Dudfield; Prof. T. Hayter Lewis, F.R.I.B.A.; Magnus Ohren, A.M.INST.C.E.; Henry C. Stephens, F.C.S.; and J. Edward Lingard, A.M.INST.C.E.

The Committee appointed by the Council to carry out further experiments on Cowls and other automatic means of ventilation, reported to the Council that they had completed their experiments on

the anemometers and air meters, but were in want of funds to carry out the experiments on Cowls.

The Council resolved to grant £150 to the Committee to enable them to complete the tests and experiments on the Cowls.

The Committee thereupon fitted up the necessary appliances at the experimental stage erected at Kew Observatory, and carried out a long and exhaustive series of experiments on various forms of cowls and coverings for ventilating pipes. By this means the Committee have obtained a large amount of valuable data which they are now engaged in tabulating and reducing to form the basis of their report.

The proposed publication of an abstract of the writings of the late Dr. William Farr, which was mentioned in the last report, has met with general favour: 560 persons have sent in their names as subscribers to the work. Owing to the amount of labour involved in selecting and arranging the matter for publication, it will be some months before the copies can be delivered to the subscribers. The price, after the close of the subscription list, will be raised from one guinea to thirty shillings.

In June the Council were asked to co-operate with the Parkes Museum and the Society of Medical Officers of Health in organising a Conference on Domestic Sanitation at the International Health Exhibition. The Chairman of Council (Dr. Alfred Carpenter), Professor W. H. Corfield, and Mr. Ernest Turner, were appointed as delegates from the Institute to a joint Committee of the three Societies to carry out the matter.

The Conference lasted for a week—from the 9th to the 14th of June. An account of the meeting will be published in Vol. VI. of the Transactions of the Institute. All the papers, with the discussions which followed, are printed *in extenso* in Vol. VIII. of the Health Exhibition Literature; they will not, therefore, be reproduced in the Transactions of the Institute.

At the close of the Health Exhibition the Council of the Institute brought under the notice of H.R.H. the Prince of Wales the desirability of forming an amalgamated Health Institute, which, although preserving to a large extent the integrity of the societies working in various branches of sanitation, might combine and centralise their actions.

It was mentioned in the last Report that the Institute had associated their offices with the Parkes Museum; during the year, twelve lectures have been given by that Institution, which the Members of the Sanitary Institute have had the opportunity of attending.

The Members of the Sanitary Institute also have access to the valuable Library of the Museum, which has lately been largely increased by the addition of the Health Section of the Library of the International Health Exhibition.

The Congress and Exhibition this year will be held in Leicester, in accordance with an invitation from the Town Council. The proximity of this town to London renders it very easy of access, and the Council trust that the Members will do their utmost to make the meeting as successful as the preceding ones have been.

SANITARY INSTITUTE OF GREAT BRITAIN.

Abstract of Cash Receipts and Payments for the Year ending December 31st, 1884.

	£	s.	d.	£	s.	d.
To Balance in hand, Petty Cash, December 31st, 1883:—				15	0	0
„ Fellowship Fees	52	10	0			
„ Admission „	76	13	0			
„ Life Compositions	129	3	0			
				258	6	0
„ Annual Subscriptions	290	17	0			
„ Examinations	137	11	0			
„ Congress	90	13	9			
„ Transactions and other Publications ...	40	10	4			
„ Medals and Certificates	0	10	6			
				560	2	7
„ Dr. Farr's Works...				3	3	0
„ Transfer from Exhibition Account ...				300	0	0
				£1136	11	7

	£	s.	d.	£	s.	d.
By Balance overdrawn				16	3	2
Office Furniture	2	2	6			
Rent and Taxes	64	7	6			
Salaries and Wages	190	8	6			
Postage, Telegrams, and Carriage	51	4	7			
Incidental Expenses	30	6	3			
Stationery and Printing ...	74	6	11			
Library	1	16	11			
Transactions	15	5	6			
Medals and Certificates	23	7	6			
				453	6	2
Congress	217	1	10			
Examination Expenses	130	3	10			
				347	5	8
„ Cowl Experiments	150	0	0			
„ Dr. Farr's Works	47	16	0			
				197	16	0
„ Balance at Bank December 31st, 1884				122	0	7
				£1136	11	7

EXHIBITION ACCOUNT.

	£	s.	d.
To Balance 1st of January, 1884	503	9	10
„ Receipts	813	4	10
	£1316	14	8

	£	s.	d.
By Expenditure	743	16	6
„ Transfer to General Account	300	0	0
„ Balance at Bank December 31st, 1884	272	18	2
	£1316	14	8

Audited and Confirmed,

April 23rd, 1885.

MAGNUS OHREN,
ERNEST TURNER, } *Auditors.*

ADDRESS

By Dr. Alfred Carpenter,

CHAIRMAN OF COUNCIL.

Read at the Annual Meeting, 1885.

Gentlemen,—It now becomes my duty, as the Chairman of your Council, to make a few observations upon current events. At our last annual meeting I took the liberty of suggesting that the time was at hand for some more defined action to be taken by the promoters of Sanitary Science, so as to endeavour to amalgamate the loose sticks in the sanitary world into one powerful bundle. The suggestion has been taken up in various quarters and favourably considered by your Council, as well as by a number of those who, like us, are more interested in the general welfare of the public than in pushing their own personal claims to office. I hope, therefore, that the day is not far distant when the yearnings of one's heart may be realised by the establishment of an Institute or College of Health under a Royal Charter, having a defined but comprehensive basis; in which we may find all the good belonging to The Sanitary Institute of Great Britain, with the advantages attached to the "Parkes Museum," the National Health Society, the Epidemiological, and the Society of Medical Officers of Health, with similar associations, all meeting in one building, each retaining its own autonomy, providing lectures on a large scale for the instruction of the masses in all those points bearing upon public health which it is so important that the public should be properly instructed in; and also having the direction of enquiries as to the causation and production of enthetic disease, such as have been foreshadowed as proper subjects for endowment at South Kensington. I refer at once to this important point, because since we met at our last annual meeting, the International Health Exhibition has been held at South Kensington, advantage has been taken of a popular desire for instruction in sanitary work, and an immense mass of information upon Health subjects has been put before the public. The caterers for amusement have blended the pennyworth of bread with the gallon of sack, and whilst promoting a good work have done many insanitary acts; probably on the principle that the end justifies the means. Let us earnestly hope that the evil which attended upon the South Kensington assemblies may be evanescent, whilst the good may be permanent, and produce substantial benefit in the future. Indeed, I think it will be so. I have every hope that our Gracious Prince will

himself take care that his name shall not be associated with the South Kensington assemblies for nothing.

It should be known to the members of the Sanitary Institute that as soon as the Exhibition was closed, and it was understood that there would be a considerable balance in the hands of the Prince, as the result of that demonstration; and that it also appearing as if a scramble was to take place for that balance, your Council agreed to some resolutions as to its destination. These were forwarded, as suggestions to the Prince, with a respectful request that a deputation from the Council should have an interview with His Royal Highness, for the purpose of pointing out somewhat in detail the course which your Council thought to be most advantageous to sanitary science, in its apportionment and utilisation.

The engagements of His Royal Highness, and his absence from London for a long period in the autumn of last year, prevented the Prince receiving the suggested deputation, but we were courteously listened to by Mr. Knollys, his Private Secretary; our proposals were heard very patiently, and ultimately put before the Prince as suggestions emanating from a body of gentlemen who did not themselves want to partake of the spoils. We only wished that they should be utilised in the best manner, so as to be devoted to the development of preventive measures, and in antagonism to those which manufacture disease.

It was the impression of most of the members of your Council that an enlargement of the principles upon which the "Parkes Museum" has been founded; by the formation of a Council of Lecturers upon Hygienic subjects, meeting at the Museum—to which should be added a commodious theatre, so that it might be properly utilised for public instruction—together with the endowment of research in connection with causes which set up disease development; would be a worthy field of promise for the utilisation of the funds left in the hands of the Prince. Such funds could not be more appropriately used, and would thus form a substantial basis for the expansion of the future Institute of Health.

The action of this Sanitary Institute of Great Britain, together with that of a considerable number of other spirits moving in various directions, has resulted in a reconsideration and a postponement of the distribution of the balance in the hands of the Prince until after some other exhibitions have been held at South Kensington, by the aid of which that balance may be either increased or frittered away. We believe that the good common sense of the Prince will prevent the latter event from coming to pass. Be it as it may, it is to be hoped that the Institute will not lose sight of the goal to which our

efforts should be continuously directed, and though it may be deferred, we trust that it is only for a definitely short time.

There are two or three subjects which have been much before the Sanitary world during the past year, upon which I shall ask you to allow me to say a word or two before retiring from this chair; one of these has reference to the "Housing of the poor." An application was made by your Council to the Royal Commission which has been appointed to enquire into this subject, suggesting that we should offer some evidence upon the matter, which the Prince of Wales was himself investigating, as Chairman of that Commission. It appeared to your Council that an offer made by so important a body as this Institute should have been at once acceded to by the Commission, without limitation as to direction which their evidence should take; but for some reason, the offer was accepted with such conditions attached to it as led the Council at once to decline to comply with those conditions, and to wait for the development of future events. It is not to be supposed nor suggested for one moment that the Prince of Wales had anything to do with this want of courtesy which was shown to your Council. It was thought by some of your Council that there were important matters connected with the dwellings of the poor, which the Examiners appointed by this Institute could have expatiated upon to the advantage of the Commission, especially as regards the incompetency of many of those men who have to see that the bye-laws of a local authority are properly enforced, and that those bye-laws be also intelligently understood by those who have to enforce them: and still more because they could have shown that the laws of the realm are frequently not enforced when they are antagonistic to the interests of the powers that be, and that energetic officials are not desired. This is but too manifest, by the treatment which an eminent practical sanitarian has recently received at the hands of the St. Pancras Vestry. It is well within the knowledge of members of your Council that there is a considerable defect in these directions; without an intelligent acquaintance with the reasons why this or that law has been enacted, it is quite useless to expect poor dwellings to continue to be healthy, however well they may have been designed in the first instance; an antecedent which is not, however, always forthcoming, and but too often it is all but impossible on present foundations to make them what they should be. The Council would have also put before the Commission evidence as to the perversion which frequently takes place in well considered plans, simply because the sanitary principles upon which those plans have been designed have not been understood by those who have been appointed to carry out the orders of the local authority,

even when it has been to see that its own provisions be complied with. Evidence could also have been adduced as to the way in which sanitary authorities, entrusted with the enforcement of the law, have openly set that law at defiance, and assisted to cause increased overcrowding by the action taken by individual members of the authority in evading the provisions of the clauses as to Lodging Houses, and also of those which apply to certain manufactories, by means of which the evils arising from overcrowding, with all their accompanying mischiefs, have been increased.

They would also have shown that building has been allowed in times past by local authority upon sites and within walls which were utterly unfitted, from preceding use, to be occupied as dwelling-houses; that ventilation was not thought to be necessary for health, and that light was sometimes so shut out that it was utterly impossible for those living in such places to enjoy even a minimum of health; whilst the equally necessary article which is required for existence, viz., water, was sometimes conspicuous by its absence. They would have shown that in some places in the metropolis the allowance for W.C. accommodation is of that character that the requirements of decency cannot possibly be complied with, and as a consequence moral degradation of the very worst kind must and does naturally follow. Members of your Council could have shown that whilst landlords are able to crowd up their dark, unventilated dwellings with double the number of families under one roof as compared with the number of living rooms, that it is utterly impossible for our people to be healthy, either morally or physically, and that it is among those who occupy part of a room, or at most one room only, that the pests of society have their continued development. That on the other hand it is among the occupants of single rooms that the majority of those who transgress the laws of the land continue to reside, and to contaminate the young children with whom they cohabit, causing the latter to follow in their path of vice at even a more rapid pace than the teachers themselves. They would also have shown that the effect is closely related to the proprietorship of houses for the sale of intoxicating liquors, which alone seem to prosper by the ignorance, the filthiness, and brutality of a given neighbourhood. It is the opinion of some of us that the relationship of one-roomed tenements with social degradation, and the close aggregation of public houses and drinking shops in confined areas, are something more than coincident facts. That until some means are forthcoming for the limitation of such houses, immorality, crime, and disease, will go hand in hand together, and the latter will not be materially abated, at least not so

much as earnest Sanatarians know it to be capable of. We know that immorality, crime, and disease are concomitant effects, that they have a distinct relationship one with the other, and that if the causes for their production be left at work, causes which promote any one of the three, the others will continue among us in spite of the enforcement of sanitary law, or in spite of the rigorous execution of penal law, and even the spread of education. We cannot educate the habitual drunkard satisfactorily. He is found among the most intelligent in the land as well as among the most debased—indeed the educated drunkard is the most dangerous. Sanitary progress will, to my mind, be far short of its true position until the proprietors of alcoholic drinking shops are treated in a manner similar to other retailers of poison, that those who sell such shall be made liable at law for some of the consequences which follow upon the abuse of their merchandise. A noted authority upon the Bench has recently come forward in defence of the right to drink. Lord Bramwell has simply put forth arguments in favour of the right which a man has to make a beast of himself, in much the same terms as used to be held fifty years ago in favour of Smithfield Market and all other insanitary surroundings. He has only reiterated, in similar language, the objections which used to be held to sanitary work in general. The Englishman's house was said to be his castle. Law has clearly shown that a man shall not turn his house, or even the surroundings of it, into a nuisance, injuriously affecting the health and comfort of his neighbours. That which is law as to a man's house, must in time apply to the man himself as well as to his domicile; though I hope better results from the spread of true knowledge upon sanitary subjects than from hostile compulsion. I hope more from the teachings of the Sanitary Institute than from legal pressure, except that pressure which arises from local option and obedience to general principles connected with the sale of poisons.

There is another point which may fairly be considered by the Institute, and upon which they ought to be competent to form an opinion, viz., the question of over-pressure in elementary schools. The battle has been fought beyond the boundary of our camp, and yet it is one in which we ought to have a voice and to join issue in the struggle. Whatever tends to raise the brain power of the people or to lessen their constitutional strength, is within our scope, and ought not to be left untouched by our members.

I am not now about to enter into the arena with either Dr. Crichton Browne or Mr. Fitch; opposite as their opinions now appear to be I think that they are both right, and if so, then, to some extent, both are wrong. One thing is manifest, that the

health of the children who frequent elementary schools is decidedly better now than it was a few years ago. Statistics show a lower death-rate among children under 13 years of age, than before the Education Act was passed; proving at any rate that the conditions under which those children live are safer now than they were before that Act became law. Nevertheless, I am with Dr. Crichton Browne on some of his points. I fear that we are aggregating masses of children together and forcing mental work, whilst we are to some extent neglecting that physical education which is equally if not more important for our welfare as a nation. The town populations are increasing, the rural population diminishing. The endurance of the latter under continued muscular strain is much greater than the former. The feet of the town dweller soon blister on a forced march, whilst those of the other scarcely feel the extra rub. It may be that there is a day of trial before us, in which the power to think, which is partially developed by School Board education, will produce for us a nation of cowards, because the larger part are physically weak and are a short-sighted people, instead of such as our great public schools have made our middle and upper classes. I believe that it is the duty of the managers of elementary schools to provide extensive playgrounds, and encourage athletics among both boys and girls, to teach the latter a little more the principles of domestic economy, if we are to counteract the evils which may arise from injudicious or excessive brain work, and the weakened bodily state which overcrowding produces in the animal as well as the vegetable world. It cannot be doubted but that there is an increase of short-sightedness among those who study much, and that which affects the set of muscles regulating the eyeball equally affects other muscles in the body. The spinal weakness upon which Myopia depends will diminish our national steadiness, and may cost us dear in the end. To have to wear spectacles when taking aim with the rifle is not conducive to dexterity in the use of the weapon.

I may mention a fact in connection with this subject which has an important bearing upon the question before us, and which is worthy of deep thought by those who have to assist in the education of the young. The establishment for pauper children at Anerley accommodates some 900 little ones, between the ages of 3 and 15. The Board of Management were much exercised by the unruliness of the children, in the night; they did not sleep well, and as a consequence of wakefulness, they did as boys and girls will do, bolster each other in the dormitories; they damaged pillows, sheets, and night-dresses, in ways which exhausted the ingenuity of a talented and

judicious superintendent, to circumvent. At this juncture it was determined to employ a drill master, at a moderate salary, to drill the children, both boys and girls, and practice them on a regular gymnastic plan. The children enjoyed their fun; they sang songs, and exercised their muscles in concert, with a marvellous dexterity. They wonderfully improved both in the production of sound and the development of figure. But an unexpected event also happened: there was a cessation of disorder in the dormitories, the damage to bed linen ceased, and the slumbers of the children were not disturbed by avalanches of pillows. Their little muscles were tired out before they went to bed, and they no longer let off their unused energy at inconvenient periods. But the act of the managers excited the ire of the guardians of the public purse. It seemed to those lynx-eyed representatives of the overtaxed ratepayer, that the paupers at Anerley were having a luxury which the Guardians could not give their own children. Remonstrance after remonstrance was made, and the managers had to dismiss their drill-master. But what happened? The disorder returned in the dormitories, and the damage inflicted upon pillows and night dresses was far in excess of the cost of the drill-master's salary, let alone the damage which must have ensued to the brains of the little ones whose unused muscular energy was let off when "Nature's sweet restorer" ought to have held them fast in her embraces. This fact was so patent to the managers that they restored the drill-master in spite of the antagonistic influence which came from the different Boards of Guardians who appointed them to office. I recommend this fact to your notice with the hope that the Sanitary Institute of Great Britain will look into the question of elementary education, and not leave it outside the pale of our work. Go into a plantation of young trees, see how they destroy each other if they are not thinned out; the same unhealthy process is at work in overcrowded schools. Look at those plants which are deprived of light, how unable are they to bear the storms which come on at not infrequent intervals. The same result is happening amongst those who are deprived of a fair share of sunlight in the courts and alleys of our towns.

It strikes me as an important point also that the elementary schools should be very frequently supervised by the Medical Officers of Health. Ventilation is provided for by the department when the schools are built, but there is no power to keep them ventilated. Those who happen to go into a large school about half an hour before the work of the day is over will generally experience a proof of vitiated air (by nasal means) which cannot be healthy for children to breathe. The floor space is not anything

like sufficient for the number of children which occupy the building, and it is possible, also, if it be a cold day that the ventilators are closed. The Medical Officers of Health ought to have power to analyse the air of the room from time to time, and to examine the condition of the ventilators, so that the neuralgic state of the master may not lead to the tuberculization of the children. I can hardly pass over the evidence which has been adduced in favour of the coincidence of some forms of tubercular disease, especially Phthisis, with parasitic life. It is said by one class of men that the Tubercle Bacillus, which has been recently shown to be a reality, is the cause of the disease, whilst another class of thinkers urge that it is only a sequence. The fact, however, is thoroughly established that a particular bacillus is found in the sputa of at least one class of phthisical patients, and also in one form of tubercular matter, which has its habitat in the lungs. It seems to be clear that the removal of the bacillus by anti-parasitic means assists to prolong the patient's life, and that the chances of recovery from the effects of tubercle are much assisted by means which destroy the parasitic germs. It may be like to the blight upon flowers. Some say that if plants are healthy they will not be touched by blight, whilst others assert that the blight destroys the health and only kills the more delicate in a more rapid manner. It may be so; I prefer to prevent, when possible, the increase of the disease by destroying the germ. Acting upon that principle, I believe I have saved several from becoming the victims of phthisis. If our elementary schools are allowed to spread the bacillus among those who are brought together in such close proximity as we do so find them in some of the Board Schools, with an individual allowance of 80 cubic feet of air, it may be in the future that whilst the deaths before thirteen years of age are diminished, those which take place in the next decade may be raised to a higher level. At any rate, it is a question which ought to be deeply interesting to our members; and if these general references to these points should cause some among you to take it up more seriously, I shall have gained my point. I thank you for the kind consideration with which I have been treated during my two years of office, and earnestly hope that the progress of the Institute may continue to be even a more forward one in the future than it has been in the past.

NOTE.—Since the above address was delivered, the report of the Royal Commission has been issued. I am rejoiced to find that the points I wished to have brought before the Commission have been brought out by the intellectual men who have formed that body.

A. C.

THE WATER SUPPLY OF ANCIENT ROMAN CITIES.

ADDRESS BY PROFESSOR W. H. CORFIELD, M.A., M.D.

Anniversary Meeting, July 9th, 1885.

As the supply of water to large populations is one of the most important subjects in connection with sanitary matters, and one upon which the health of those populations to a very large extent depends, I have thought that it would not be uninteresting to the members of this Institute were I to give them a short account of some of the more important works carried out for this purpose by the Ancient Romans—the great sanitary engineers of antiquity—more especially as I have had exceptional opportunities of examining many of those great works in Italy, in France, and along the north cost of Africa. Many of them are well known, and have often been described, but others, and those, as we shall see, in many respects by far the most important, have not received the amount of consideration that they deserve.

Of the aqueducts constructed for the supply of Rome itself we have an excellent detailed account in the work of Frontinus, who was the controller of the aqueducts under the Emperor Nerva, and who wrote his admirable work on them about A.D. 97.

It may be interesting in passing to mention that Frontinus was a patrician, who had commanded with distinction in Britain under the Emperor Vespatian, before he was appointed by the Emperor Nerva as controller (or, we should say, surveyor) of the aqueducts. He was also an antiquarian, and in his work he not only describes the aqueducts as they were in his time, but also gives a very interesting history of them.

He begins by telling us that for 441 years after the building of the city, that is to say, before B.C. 312, there was no systematic supply of water to the city; that the water was got direct from the Tiber, from shallow wells, and from natural springs; but that these sources were found no longer to be sufficient, and the construction of the first aqueduct was undertaken during the consulship of Appius Claudius Crassus, from whom it took the name of the Appian aqueduct. This was, as may be expected from its being the first aqueduct, not a very long one; the source was about eight miles to the east of Rome,

and the length of the aqueduct itself rather more than eleven miles, according to Mr. James Parker, to whose paper on the "Water Supply of Ancient Rome," I am indebted for many of the facts concerning the aqueducts of Rome itself. This aqueduct was carried underground throughout its whole length, winding round the heads of the valleys in its course, and not crossing them, supported on arches, after the manner of more recent constructions; it was thus invisible until it got inside the city itself, a very important matter when we consider how liable Rome was, in these early times, to hostile attacks.

It was soon found that more water was required than was brought by this aqueduct, and it was no doubt considered desirable to have tanks at a higher level in the city than those supplied by the Appian aqueduct. It was determined, therefore, to bring water from a greater height and from a greater distance, and the river Anio, above the falls at Tivoli, was selected for this purpose. The second aqueduct, the Anio Vetus, was no less than 42 miles in length, and was, like the Appian, entirely under the surface of the ground, except at its entrance into Rome at a point about 60 feet higher than the level of the Appian aqueduct. Little search has been made for the remains of this aqueduct, and its exact course is not known, but during my examination of the remains of the subsequent aqueducts at a place called the Porta Furba, near Rome, where the ruins of five aqueducts are seen together, and at, or close to, which point the Anio Vetus must also have passed underground, I was rewarded for my search by discovering a hole, something like a fox's hole, leading into the ground, and on clearing away a few loose stones which had apparently been thrown into it, and putting my arm in I found that it led into the specus or channel of an underground aqueduct, and on relating this incident to the late Mr. John Henry Parker, the antiquarian, who was then in Rome, and showing him a sketch of the place, he said that he had no doubt that I had been fortunate enough to discover the exact position of the veritable Anio Vetus at that spot.

These two aqueducts sufficed for the supply of Rome with water for about 120 years, for Frontinus tells us that 127 years after the date at which the construction of Anio Vetus was undertaken, that is to say, the 608th year after the foundation of the city, the increase of the city necessitated a more ample supply of water, and it was determined to bring it from a still greater distance. It was no longer considered necessary to conceal the aqueduct underground during the whole of its course, and so it was in part carried above ground on embankments or supported upon arches of masonry. The water was

brought from some pools in one of the valleys on the eastern side of the Anio, some miles further up than the point from which the Anio Vetus was supplied, and the new aqueduct, which was 54 miles in length, was called the Marcian, after the Prætor Marcius, to whom the work was entrusted. Frontinus also tells us the history of the other six aqueducts which were in existence in his time, viz:—the Tepulan, the Julian, the Virgo, the Alsietine or Augustan, the Claudian, and the Anio Novus; the last two being commenced by the Emperor Caligula, and finished by Claudius, because "seven aqueducts seemed scarcely sufficient for public purposes and private amusements;" but it is not necessary for our purpose to give any detailed account of the course of these aqueducts, it is only necessary to mention one or two very interesting points in connection with them.

In order to allow of the deposit of suspended matters, piscinæ, or settling reservoirs, were constructed in a very ingenious manner. Each had four compartments, two upper and two lower; the water was conducted into one of the upper compartments and from this passed, probably by what we should call a standing waste or overflow pipe, into the one below; from this it passed (probably through a grating) into the third compartment at the same level, and thence rose through a hole in the roof of this compartment into the fourth, which was above it, and in which the water of course attained the same level as in the first compartment, thence passing on along the aqueduct, having deposited a good deal of its suspended matter in the two lower compartments of the piscina. Arrangements were made by which these two lower compartments could be cleaned out from time to time. The specus or channel itself was of course constructed of masonry, generally of blocks of stone cemented together, and it was frequently, though not, it would appear, always, lined with cement inside. It was roofed over, and ventilating shafts were constructed at intervals; in order to encourage the aëration of the water irregularities were occasionally introduced in the bed of the channel.

The water supplied by the different aqueducts was of various qualities; thus, for instance, that of the Alsietine, which was taken from a lake about 18 miles from Rome, was of an inferior quality, and was chiefly used to supply a large naumachia, or reservoir in which imitation sea fights were performed; while on the other hand, the water of the Marcian was very clear and good, and was therefore used for domestic purposes.

Frontinus gives the most accurate details as to the measurements of the amounts of water supplied by the various aqueducts, and the quantities used for different purposes. From these

details Mr. Parker computes the sectional area of the water at about 120 square feet, and says: "We can form some opinion of the vast quantity if we picture to ourselves a stream 20 feet wide, by 6 feet deep, constantly pouring into Rome at a fall six times as rapid as that of the River Thames." He considers that the amount was equivalent to about 332 million gallons a day, or 332 gallons per head per day, assuming the population of the city to be a million.

When we consider that we in London have only 30 gallons a head daily, and that many other towns have less, we get some idea of the profusion with which water was supplied to ancient Rome.

But the remains of Roman aqueducts are not only to be found near Rome. Almost every Roman city, whether in Italy or in the south of France, or along the north coast of Africa, can show the remains of its aqueduct, and almost the only things that are to be seen on the site of Carthage are the remains of the Roman water tanks, and the ruins of the aqueduct which supplied them.

The most beautiful aqueduct bridge in the world, on the course of the aqueduct which supplied the ancient Nemaucus, now Nismes, still stands, and is called from the name of the Department in which it is, the Pont du Gard. It consists of a row of large arches crossing the valley over which the water had to be carried, surmounted by a series of smaller arches, and these again by a third series of still smaller ones, carrying the specus of the aqueduct. This splendid bridge still stands perfect, so that one can walk through the channel along which the water flowed, and it might be again used for its original purpose.

There was, however, one city which, from the fact that a great part of it was situated upon a hill, was more difficult to supply with water than any of the rest, and which, at the same time from its size, its great importance, and the fact that it was the favourite summer residence of several of the Roman Emperors, and notably of Claudius, who was born there, and who had a palace on the top of the hill, must of necessity be supplied with plenty of water, and that too from a considerable height. I refer to Lugdunum (now Lyons), then the capital of Southern Gaul.

A somewhat prolonged residence in this city on two different occasions gave me the opportunity of examining on the spot the remains of the aqueducts constructed there by the ancient Romans, and more especially of the one constructed by the Emperor Claudius, and so, as they are but little known, although by far the most remarkable of the Roman waterworks, I have

thought that it would not be uninteresting to you if I were to give, with the aid of the diagrams I have prepared, a somewhat detailed account of them.

The city of Lugdunum was built by Lucius Munatius Plaucus, by order of the Senate in A.U.C. 711. Augustus went there in A.U.C. 738, and afterwards lived there from 741 to 744. It was he who raised it to a very high rank among Roman cities. It had its Forum near the top of the hill now called Fourvières (probably a corruption of Forum Vetus), an Imperial palace on the summit of the same hill, public baths, an amphitheatre, a circus, and temples.

In order to supply this city with water, standing as it did on the side of a hill at the junction of two great rivers (now Rhone and Soane), it was necessary to search for a source at a sufficient height, and this Plaucus found in the hills of Mont d'Or, near Lyons, where a plentiful supply of water was found at a sufficient height, viz., that of nearly 2000 feet above the sea. From this point an aqueduct, sometimes called from its source the aqueduct of Mont d'Or, and sometimes the aqueduct of Ecully, from the name of a large plain which it crossed, was constructed, or rather two subterranean aqueducts were made and joined together into one, which crossed the plain of Ecully, in a straight line still underground; but the ground around Lyons was not like the Campagna, near Rome, and it was necessary to cross the broad and deep valley now called La Grange Blanche. This, however, did not daunt the Roman engineers: making the aqueduct end in a reservoir on one side of the valley, they carried the water down into the valley, probably by means of lead pipes, in the manner which will be described more at length further on, across the stream at the bottom of the valley by means of an aqueduct bridge 650 feet long, 75 feet high, and 28 feet broad; and up the other side into another reservoir, from which the aqueduct was continued, along the top of a long series of arches, to the reservoir in the city, after a course of about ten miles.

In the time of Augustus, however, it was found that the water brought by this aqueduct was not sufficient, especially in summer, and as there was a large Roman camp, which also required to be supplied with water, situated at a short distance from the city, it was determined to construct a second aqueduct. For this purpose the springs at the head of a small river, called now the Brevenne, were tapped, and conveyed by means of an underground aqueduct (known as the aqueduct of the Brevenne) which wound round the heads of the valleys, and after a course of about 30 miles is believed by some to have arrived at the city, but by others to have stopped at the Roman camp, and to

have been constructed exclusively for its supply. I have here a diagram (after Flachéron) shewing a section of this aqueduct, and this will give a very good general idea of the section of a Roman aqueduct where constructed underground. It will be seen that the specus or channel is 60 centimetres (or nearly 2 feet) wide, and 1 m. 57 c. (or a little over 5 feet) high, and that it is lined with a layer of 3 c. (or nearly 1¼ inches) of cement. It is constructed of quadrangular blocks of stone cemented together, and has an arched stone roof (Fig. 4). It will be noticed also that the angles at the lower part of the channel on each side are filled up with cement; it appears also that this aqueduct crossed a small valley by means of inverted siphons.

But neither of these aqueducts came from a source sufficiently high to supply the imperial palace on the top of Fourvières. Their sources are, in fact, according to Flachéron, at a height of nearly 50 feet below the summit of Fourvières, and it was, therefore, considered necessary by the Emperor Claudius to construct a third aqueduct. The sources of the stream now called the Gier, at the foot of Mont Pila, about a mile and a half above St. Chamond, were chosen for this purpose, and from this point to the summit of Fourvières was constructed by far the most remarkable aqueduct of ancient times, an engineering work which, as will be seen from the following description, partly taken from Montfalcon's history of Lyons, partly from Flachéron's account of this aqueduct, and partly from my own observations on the spot, reflects the greatest possible credit on the Roman engineers, and shows that they were not, as has been frequently supposed by those who have only examined aqueducts at Rome, by any means ignorant of the elementary principles of hydraulics.

To tap the sources of a river at a point over 50 miles from the city, and to bring the water across a most irregular country, crossing ten or twelve valleys, one being over 300 feet deep, and about two-thirds of a mile in width, was no easy task, but that it was performed the remains of the aqueduct at various parts of its course show clearly enough. It commences, as I have said, about a mile and a half from the present St. Chamond, a town on the river Gier, about 16 miles from St. Etienne. Here a dam appears to have been constructed across the bed of the river, forming a lake from which the water entered the channel of the aqueduct, which passed along underground, until it came to a small stream which it crossed by a bridge, long since destroyed. After this it again became subterraneous for a time, and then crossed another stream on a bridge of nine arches, the ruins of some of the columns of which are still to be seen, and from these ruins it would appear that the bridge

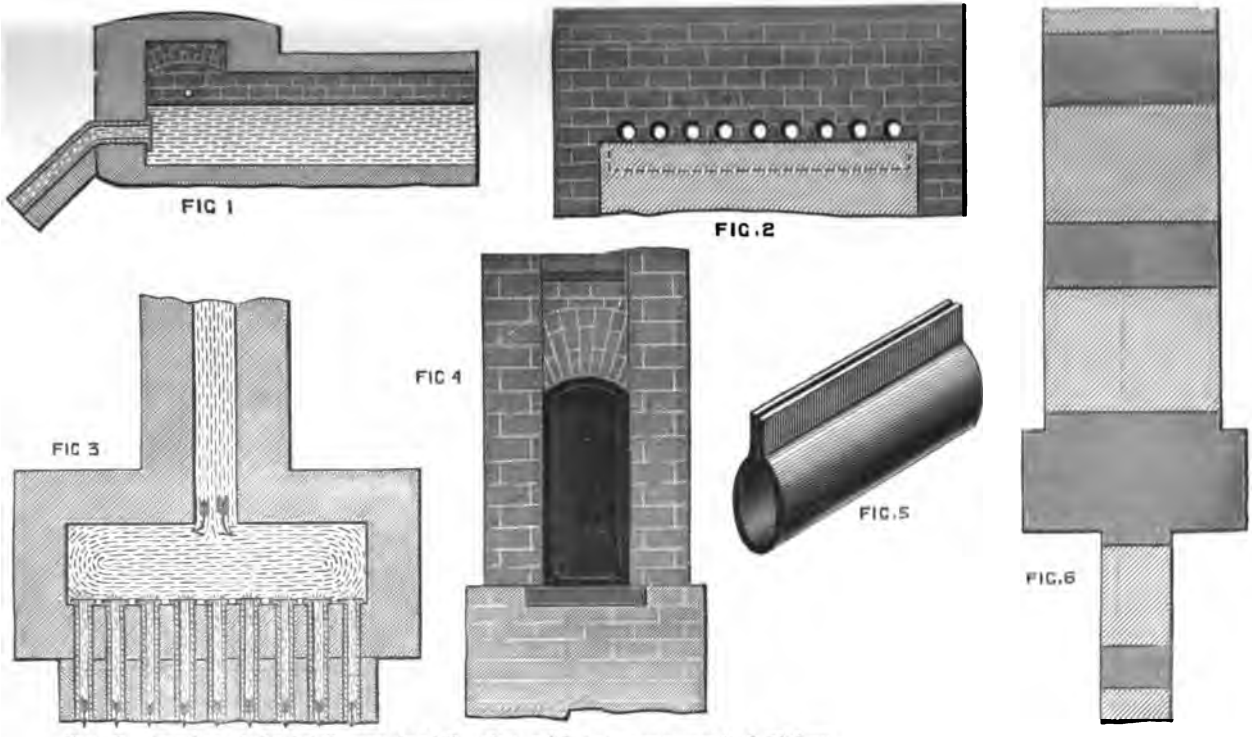


FIG. 1. Section of Outlet Reservoir at Soucieu, with commencement of Siphon.
„ 2. Part elevation of Outlet Reservoir at Soucieu, shewing hole for 9 Siphons.
„ 3. Plan of Outlet Reservoir at Soucieu.
„ 4. Section of Aqueduct of the Brevenne.
„ 5. Lead Pipe for distributing water.
„ 6. Horizontal Section of Aqueduct Bridge and Outlet Reservoir at Chaponost. *(After Flachéron).*

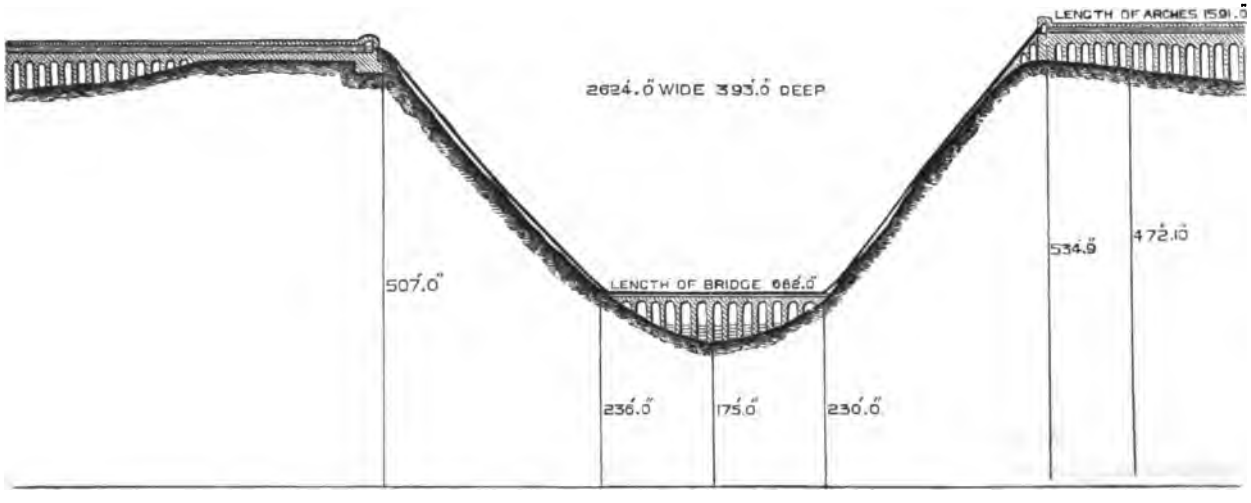
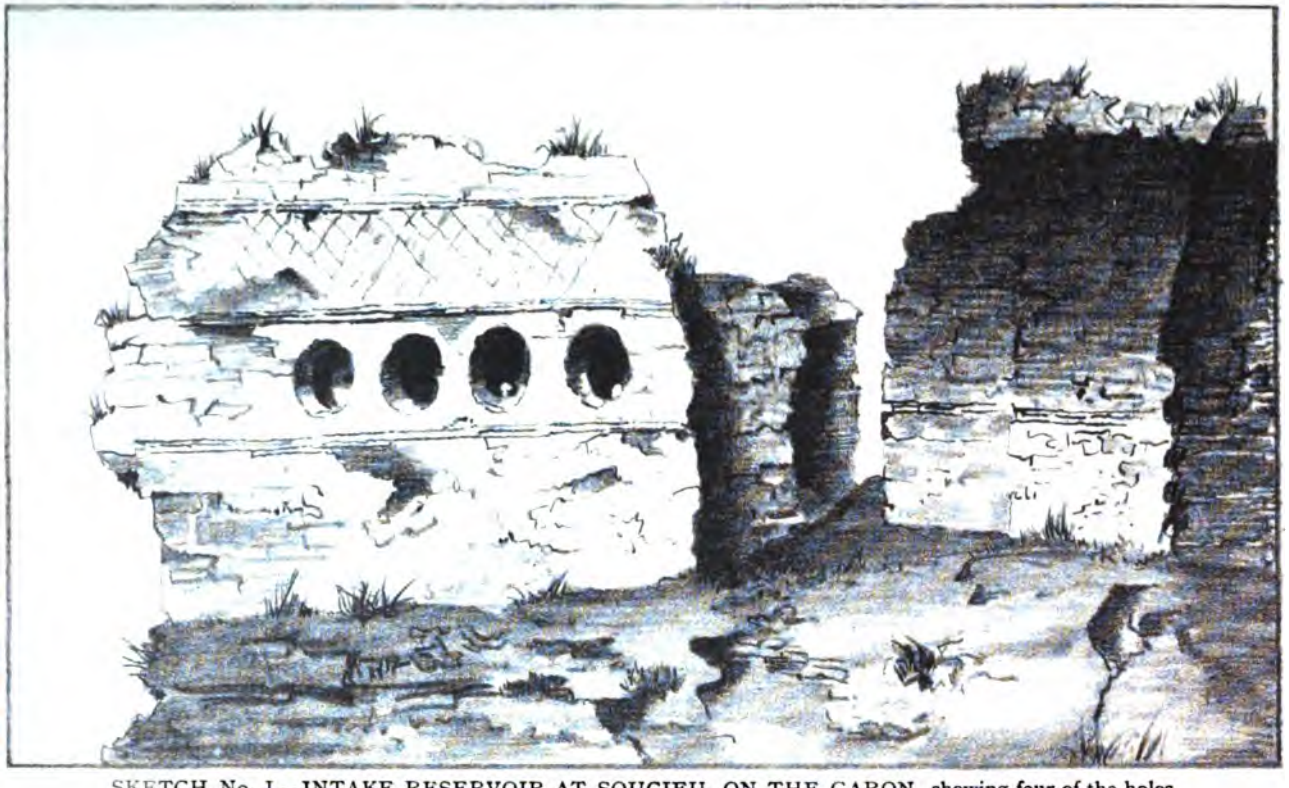
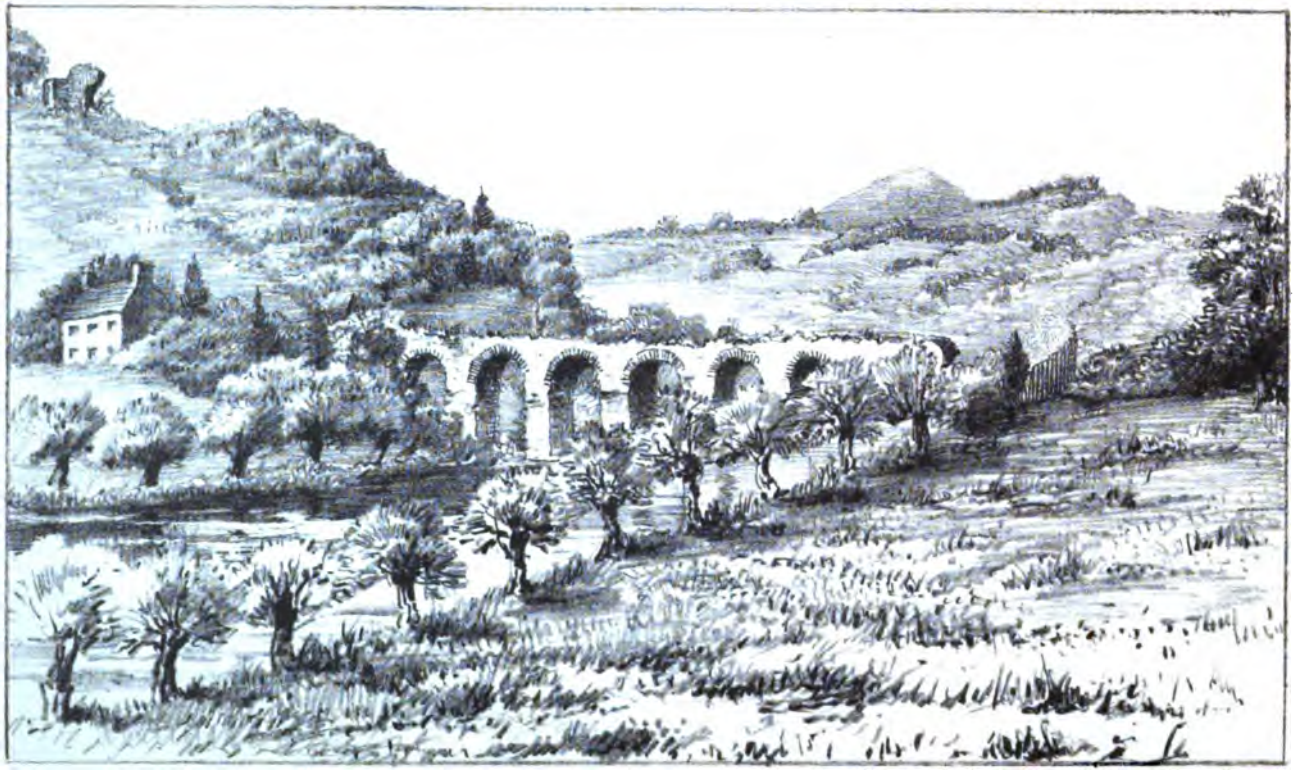


Diagram of Aqueduct Bridge, Reservoirs and Siphons, for crossing the Valley of the Garon. The Outlet Reservoir at Soucieu is on the right, the Intake Reservoir at Brignais on the left hand side. ***(After Flachéron).***

N.B.—The vertical scale is three times the horizontal.



SKETCH No. I.—INTAKE RESERVOIR AT SOUCIEU, ON THE GARON, shewing four of the holes by which the siphons started from the reservoir. *(From a Sketch by the Author.)*



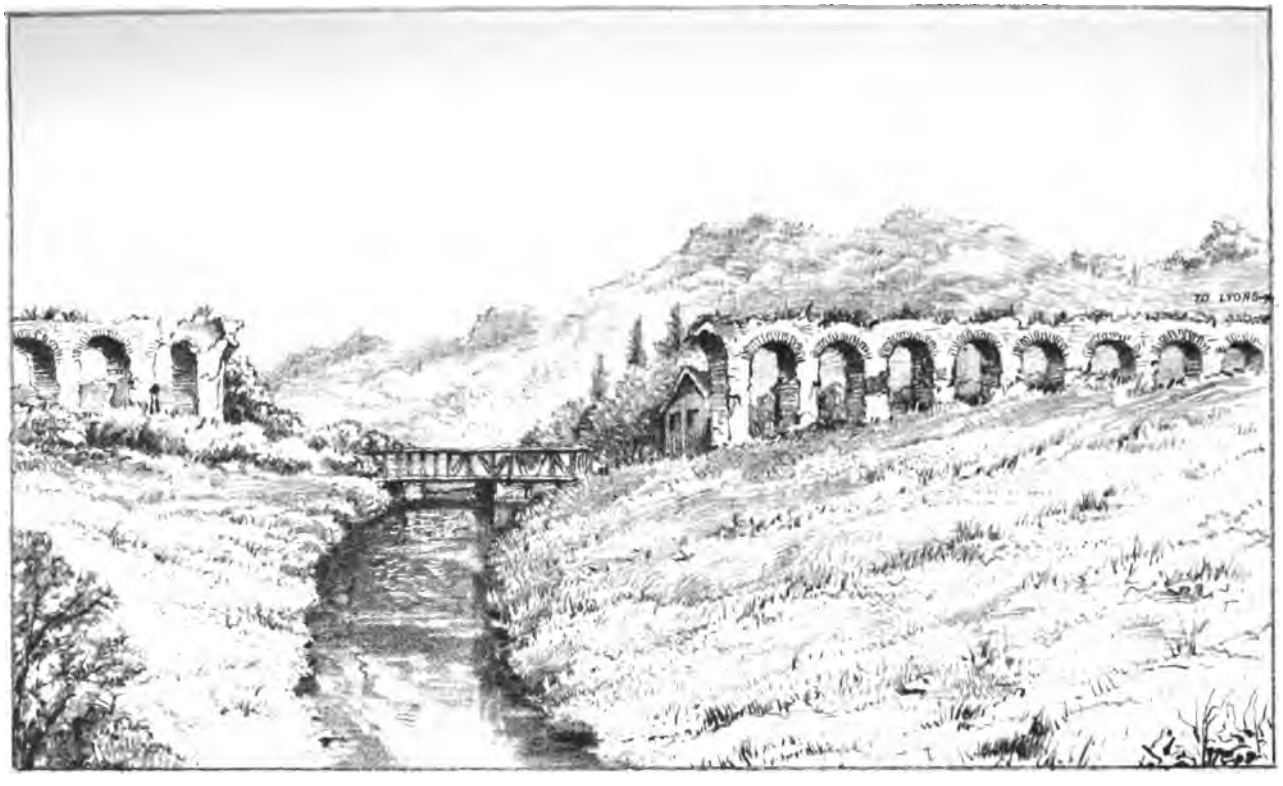
SKETCH No. II.—AQUEDUCT BRIDGE OVER THE GARON.—To carry the Siphons leading from the Intake Reservoir at Soucieu (seen at the top of the Sketch on the left-hand side) to the Outlet Reservoir at Brignais on the other side of the Valley. ***(From a Sketch by the Author.)***

had, at some time or another, been destroyed, probably by the stream running under it having become torrential, and subsequently rebuilt; again it became concealed underground, to reappear in crossing a small valley and another small stream, when it was again concealed by the ground, and in one or two places channels were even cut for it through the solid rock, after which it reappeared on the surface at a point where now stands the village of Terre-Noire, and where it was necessary that it should somehow or other cross a broad and deep valley. It ended in a stone outlet-reservoir, from which eight lead pipes descending into the valley were carried across the stream at the bottom on an aqueduct bridge, about 25 feet wide, and supported by twelve or thirteen arches, and then mounted the other side of the valley into an intake-reservoir, of which scarcely any remains are now seen, from which the aqueduct started again, disappearing almost immediately under the surface of the ground to appear again from time to time crossing similar valleys and streams upon bridges, the remains of some of which may still be seen, until it reached Soucieu, on the edge of the valley of the Garon, where are still seen the remains of a splendid bridge, the thirteenth on its course, nearly 1600 feet long, and attaining a height of 56 feet at its highest point above the ground. The object of this bridge was to convey the channel of the aqueduct at a sufficient height into a reservoir on the edge of the valley. The remains of this bridge leave no doubt that it was purposely destroyed by barbarians; some of the arches near the end of it remain, while the rest have been thrown down, some on one side and some on the other; but happily the arches next to the reservoir, at the end of the bridge and on the edge of the valley, remain, and the reservoir itself is still in part intact supported on a huge mass of masonry. Four holes are to be seen in that part of the front of the reservoir which is left, being the holes from which the lead pipes descended into the valley (see sketch No. 1). It would appear from the remains of the reservoir that there must have been nine of these pipes in all. These holes are elliptical in shape, being 12 inches high by 9½ inches wide, and the interior of the reservoir is still seen to be covered with cement. The walls of the reservoir were about 2 feet 7 inches thick, and were strengthened by ties of iron; it had an arched stone roof in which there was an opening for access (Figs. 1, 2, 3). From this the nine lead pipes descended the side of the valley supported on a construction of masonry, crossed the river by an aqueduct bridge and ascended into another reservoir on the other side, as seen in sketch No. 2, entering the reservoir at its upper part just below the spring of the arches of the roof. From this

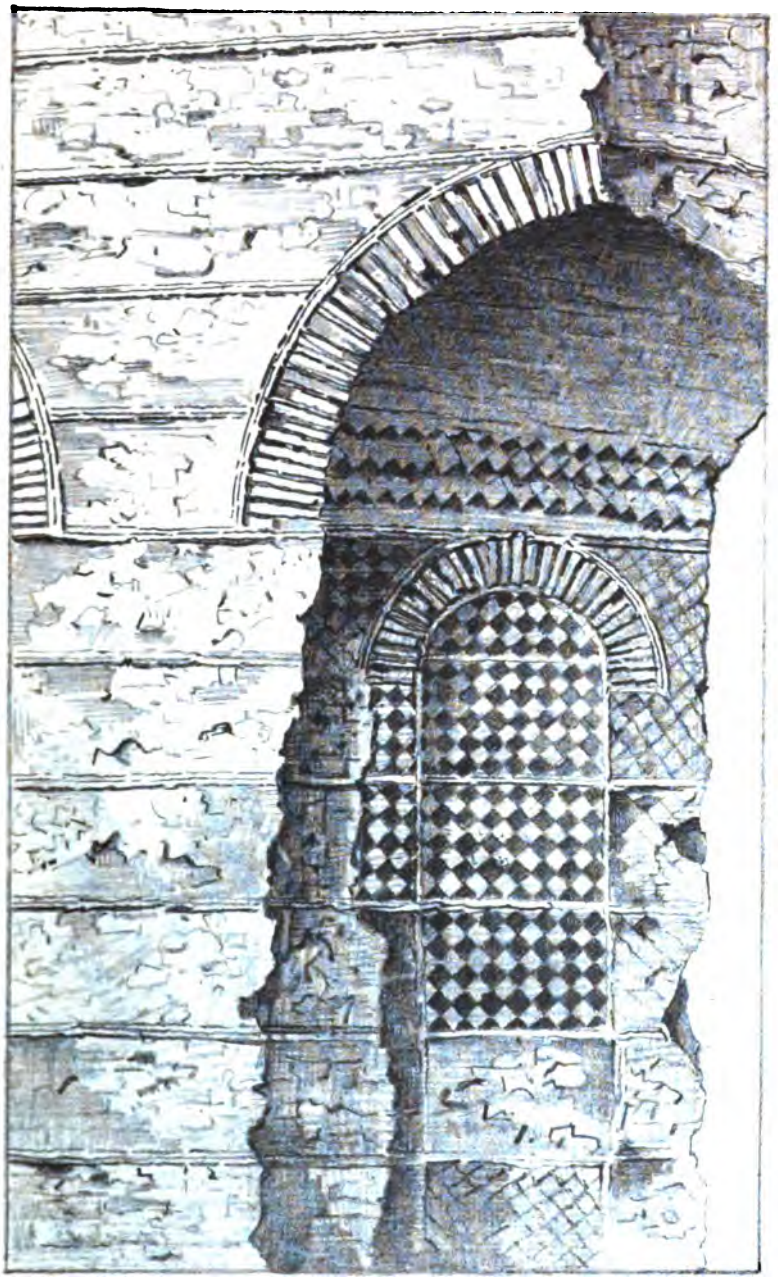
reservoir the aqueduct passed to the next on the edge of the large and deep valley of Bonnan, being underground twice and having three bridges on its course, the last of which, the sixteenth on the course of the aqueduct, ends in a reservoir near Chaponost, on the edge of the valley. Only one of the openings through which the siphons, of which there were probably ten, started from the reservoir is now left.

The bridge across the valley below had thirty arches and was about 880 feet long by 24 feet wide. A number of the arches still remain standing, and, as will be seen by sketch No. 3, in some instances the pillars of the arches were constructed of transverse arches themselves. The work consisted of concrete formed with Roman cement, so hard that it turns the points of pickaxes when employed against it, with layers of flat bricks at regular intervals. The surface of the concrete is covered with small cubical blocks of stone placed so that their diagonals are horizontal and vertical, and forming what is known as *opus reticulatum* (see sketch No. 4). After crossing the bridge the pipes were carried up the other side of the valley into a reservoir, of which little remains, and then the aqueduct was continued to the next valley, passing over three bridges in its course. This valley, that of St. Irenée, is much smaller than either of the others, but nevertheless it was deep enough to necessitate the construction of inverted siphons, of which there were eight.

Leaving the reservoir on the other side of this valley, the aqueduct was carried on a long bridge (the twentieth on its course) which crossed the plateau on the top of Fourvières and opened into a large reservoir, the remains of which are still to be seen on the top of that hill. From this reservoir, which was 77 feet long and 51 feet wide, pipes of lead conveyed the water to the imperial palace and to the other buildings near the top of the hill. Some of these lead pipes were found in a vineyard near the top of Fourvières at the beginning of the eighteenth century, and were described by Colonia in his History of Lyons. They are made of thick sheet lead rolled round so as to form a tube, with the edges of the sheet turned upwards, and applied to one another in such a way as to leave a small space, as shown in Fig. 5, which was probably filled with some kind of cement. These pipes, of which it is said that twenty or thirty, each from 15 to 20 feet long, were found, were marked with the initial letters TI. CL. CAES. (Tiberius Claudius Cæsar) and afford positive evidence that the work was carried out under the Emperor Claudius. Lead pipes, constructed in a similar manner, have also been found at Bath, in this country, in connection with the Roman baths.



SKETCH No. III—REMAINS OF AQUEDUCT BRIDGE ACROSS THE STREAM IN THE VALLEY OF BONNAN (OR BEAUNAN). The little Wooden Bridge across the Stream is supported by the remains of the Pillars of the Old Aqueduct Bridge. *(From a Sketch by the Author.)*



SKETCH No. IV.—ARCH OF AQUEDUCT BRIDGE AT BONNAN, shewing Opus Reticulatum. The dark Cubes are made of granite gneiss, etc., the light ones of limestone and sandstone; on the latter a white lichen grows, rendering the contrast still more conspicuous. The Arches are made of slabs of gneiss alternated with flat bricks. The layers of flat bricks at regular intervals are also shewn. *(From a Sketch by the Author.)*

It will be seen at once that the great difference between this aqueduct and those near Rome arises from the fact that instead of being carried across a nearly flat country, it was carried across one intersected with deep ravines, and that it was therefore necessary to have recourse to the system of inverted siphons. There can be no doubt that the inverted siphons were made of lead, although no remains of them have been found, for we know that the Romans used lead largely and, as we have seen, pieces of the lead distribution pipes have been found. It is possible, and even likely, that strong cords of hemp were wound round the pipes forming the siphons, as is related by Delorme in describing a similar Roman aqueduct siphon near Constantinople; Delorme also describes, in the aqueduct last mentioned, a pipe for the escape of air from the lowest part of the siphon carried up against a tower which was higher than the aqueduct, and it is certain that there must have been some such contrivance on the siphons of the aqueduct at Lyons. Flachéron supposes that they consisted of small pipes carried from the lowest part of the siphons up along the side of the valley and above the reservoirs, or in some instances, of taps fixed at the lowest part of the siphons. (Professor Hayter Lewis has kindly pointed out to me that Vitruvius describes these air pipes.)

The Romans have been blamed for not using inverted siphons in the aqueducts at Rome, and it has been said that this is a sufficient proof that they did not understand the simplest principles of hydraulics, but the remains of the aqueducts at Lyons, which I have been describing, negative this assumption altogether. The Romans were not so foolish as to construct underground siphons, many miles long, for the supply of Rome, but where it was necessary to construct them for the purpose of crossing deep valleys they did so. The same Emperor Claudius who built the aqueduct at Rome known by his name, built the aqueduct of Mont Pila, at Lyons, and it is quite clear, therefore, that his engineers were practically well acquainted with the principles of hydraulics.

It is thus seen that the Ancient Romans spared no pains to obtain a supply of pure water for their cities, and I think it is high time that we followed their example, and went to the trouble and expense of obtaining drinking water from unimpeachable sources, instead of, as is too often the case, taking water which we know perfectly well has been polluted, and then attempting to purify it for domestic purposes.

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CONGRESS AT LEICESTER.

SEPTEMBER, 1885.

PAPERS AND DISCUSSIONS.

CONGRESS AT LEICESTER.

INTRODUCTION.

THE Eighth Congress of the Institute was held at Leicester, from September 22nd to 26th, 1885, in accordance with an invitation received from the Town Council.

The buildings devoted to the use of the Congress were conveniently arranged for the meetings. The opening Address by the President, and the Lecture to the Congress were delivered in the Museum Lecture Hall, and the Sectional Meetings were held in the same building.

The Inaugural Address to the Congress was delivered on Tuesday Evening, by the President, PROFESSOR F. S. B. F. DE CHAUMONT.

The Lecture to the Congress was delivered on Thursday Evening, by Mr. ERNEST HART, Chairman of the National Health Society.

The papers read at the Congress were divided into three Sections: 1, Sanitary Science and Preventive Medicine; Section 2, Engineering and Architecture; Section 3, Chemistry, Meteorology and Geology; the meetings of Sections 1 and 2 occupying nearly two days each. The leading features of the Sectional meetings are given in the Secretaries' Reports, page 367.

On Tuesday a public Luncheon was provided in the Masonic Hall, Halford Street, presided over by the MAYOR, who afterwards opened the Exhibition in the Floral Hall; at the close of which ceremony, visits were paid to Buildings of Archæological interest in Leicester.

A Breakfast was given to the Members of the Congress on Wednesday Morning, by the Leicester Temperance Society, in the Temperance Hall, Granby Street. In the Evening the MAYOR gave a Conversazione at the Museum, which was largely attended.

Two interesting Excursions were arranged for Saturday: one to Belvior Castle, and the other to Charnwood Forest, where visitors were entertained at lunch by MESSRS. ELLIS and EVERARD.

The Lecture to the Working Classes, by CAPTAIN DOUGLAS GALTON, was given in the Evening, in the Temperance Hall, Granby Street.

The Exhibition was held in the Floral Hall, Belgrave Gate, which was well situated for the purpose, but a large annex had to be added to it to accommodate all the Exhibits that were sent to the Institute. It was open from Tuesday, September 22nd, to Saturday, October 10th. There were 135 Exhibitors and 1,000 Exhibits. The Judges awarded 5 Silver Medals, presented by the Exeter and Leicester Gas Companies, 29 Bronze Medals of the Institute, 11 Special Certificates, and 81 Certificates. 119 Exhibits were deferred for further Practical Trial, but the awards made for these are included in the figures given above. About 37,000 people visited the Exhibition during the nineteen days that it was open.

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By Prof. F. S. B. F. de Chaumont, M.D., F.R.S.,

PRESIDENT OF THE CONGRESS.

In opening the Eighth Congress of the Sanitary Institute of Great Britain two duties present themselves for fulfilment. In the first place I have to thank the Council of the Institute for placing me in this honourable position, which has heen filled by so distinguished a series of presidents on previous occasions—Richardson, Chadwick, Lord Fortescue, Galton, Humphrey, and Rawlinson. My second duty is, in the name of the Institute, to thank the worshipful the Mayor of Leicester and the Corporation of this ancient borough for their kind invitation to assemble here. We trust that the results of our visit will not be less interesting or less beneficial to this locality than our previous visits to other places have been in the past. The Institute will soon enter upon the tenth year of its existence, and during that period it has made great and important progress. To those who have watched its career it is interesting to see how from small beginnings it has gradually but surely worked itself into a position of prominence and influence in the country. Of course, in its early days it had struggles against opposition, reasoning and unreasoning, carping and ill-natured criticism, and even scornful and contemptuous depreciation. We were called a set of talkers and babblers, venturing to speak, to a public who knew nothing, on subjects of which we knew but little at best. One of our foreign corresponding members remarked on this subject to me on the occasion of our anniversary dinner last July, contrasting the present state of things with that which obtained in the early days of the Institute, when he visited us for the first time, how at that time we had many detractors, and how that some of those who were the least encouraging now see it advantageous to join with us in the good work that we are trying to do. As in every similar case, there were no

doubt mistakes and misfortunes in the beginning, but the ground was entirely new. We were pioneers in a new country, or perhaps, to speak more accurately, we were the first settlers in a country, which had indeed been prospected by other enterprising and intrepid men, but in which no definite settlement had yet been made. It must not be supposed that in saying this I am arrogating to ourselves the honour of founding the science of Hygiene, or of being the first to open up to the people the fountains of health which had lain so long concealed. On the contrary, we freely admit that the search after health, and its literature are the oldest in the world, and on this subject I may refer you to the opening lecture I delivered on the early history of the subject at the Parkes Museum in 1883, published in the *Lancet* of June 9th of that year. But until the Institute was founded in 1876, by a few earnest and far-seeing men, there were no institutions which undertook to bring before the public the vital question of health, both public and domestic. There was indeed the health section of the Social Science Association, and the subject was dealt with, in a more or less casual manner, by other Societies; but there was still room for a special Institution like ours, although the exact scope and definition of its labours were at first uncertain. We did not wish it to be a mere debating Society, or to be an occasion of meeting of experts in the various branches of Hygiene, but to make it a means of bringing the subject home to the community at large, in the hope of interesting each member of it individually in this great question, and of bringing the knowledge already acquired, or that might be progressively acquired in the future, to the amelioration of existing evils, and to the prevention of those which were likely to come. For this purpose it seemed to be a good plan to start a series of Meetings or Congresses, in different parts of the kingdom that might be willing to invite us to visit them, and hear what we had to say. In the year of our foundation, 1876, a Congress of Hygiene of an International character took place at Brussels, in connection with an exhibition of Sanitary and Life-Saving Appliances, on the invitation of the present King of the Belgians. With the exception of one which had taken place in the same City in 1853, under the auspices of the late King Leopold I., that of 1876 was the first Congress of the kind on record, the interval of nearly quarter of a century between them, having been a period of wars of the most severe and bloody character, quite inimical apparently to the more peaceful pursuits of the health and well-being of mankind. But, barren as that interval was of Hygienic Congresses, and fruitful of destructive wars, it was by no means a period of

Hygienic inaction; on the contrary, it was perhaps, the busiest and most eventful, as well as the most usefully productive of any that the world had ever seen. The year 1853 was, perhaps, too soon to interest the community at large, in this or any other country, on the subject of the laws of health. During the quarter of a century that preceded it great efforts had been made, in this country especially, by the work of the Health of Towns Commission and other similar bodies, and a large mass of information and evidence of a very startling character had been brought together; the General Board of Health (with which the name of our venerable friend, Mr. Edward Chadwick, is so honourably associated) had been established, although about again to cease to exist in that particular form. Still the interest of the public could hardly be said to have been sufficiently aroused to the importance of the subject, and when the dreams of the optimists of 1851, who fondly imagined that the Great Exhibition of that year was the beginning of the millenium, were rudely dispelled by the invasion of the Danubian Provinces in 1853, and by the declaration of war against Russia, by this country and France, in the spring of 1854, any one might have been forgiven for thinking that the chances of civil improvements were but small. *Inter arma silent leges*, and when war followed war in quick succession, the Crimean War being followed by the Indian Mutiny, that by the Franco-Austrian War, that again by the Civil War in America, the Danish and German Wars of 1864 and 1866, and finally the death struggle in France in 1870-1, an onlooker might well have imagined that such peaceful and unobtrusive work as the care of the peoples' health might well be forgotten when nation after nation was flying at his neighbour's or his brother's throat. But in the course of this world good often comes of evil, and results are brought about in the most unlikely way. When our army was dying in the snows of the Crimea, or in the crowded hospitals at Scutari, I am sure poor Tommy Atkins, so patient and heroic to the end, never dreamt that his sufferings and death were of more moment to mankind than the overthrow of the proudest throne, for they were to go to the making of an epoch, of a turning point in the health history of the world, to which the most striking and picturesque revolution was a mere transient stage effect. Had not our army perished in the way it did, the true principles of Hygiene might have lain dormant and unfruitful for many a long year, whereas the sacrifice of that unfortunate army has been the means of saving many lives and countless treasure to this and other countries. The various inquiries set on foot culminated in the Royal Commission of 1857, which as it were

brought to a focus the rays of light that up to that time had been somewhat scattered. The "horrible and heart-rending" details of the war were probed to the bottom, and, better and more important still, the whole facts about the life of the soldier were carefully gone into, with a view to the inquiry why he should, at home and in time of peace, die at a rate which was never reached among his civil brethren, except in times of the most virulent epidemic. Those of my own day may say that this is a thrice told tale. True, but it may not be so to the generation that has grown up since that eventful time, and it is indeed connected with so great a triumph of true Hygiene that it can hardly be too often impressed upon the public. The Report of the Royal Commission of 1857 was one of the most remarkable and instructive documents ever furnished to a Government, the investigation being so complete, the inductions so clear, and the predictions as to the future having been so fully justified by subsequent experience. The Commissioners were able to point to certain conditions which they believed to be the causes of the evils complained of, and they further said—"Let them be remedied, and there is no reason why the soldier should not be as healthy as the healthiest in civil life." The recommendations of the Commission were acted upon as rapidly as circumstances permitted, and we are now at a distance of 30 years from the former evil days. What are the facts now? The soldier at that time died at the rate of 18 per 1,000 at home, or, to be a soldier in time of peace was more fatal than to be the inmate of the filthiest and most poverty-stricken parts of our crowded cities. The last return, that of 1883, shows that the death-rate at home is only 6·28, instead of 18, and only 5·28, if we exclude violent deaths—that is, nearly 40 per cent. less than the death-rate of the most healthy districts in England and Wales. Calculating upon 80,000 men, the strength of our home army in 1883, we have 1032 men saved to the State in one year alone—and when we add to this the amount of sickness saved we find that it represents the services of 800 men for a whole year, so that practically a saving of two battalions has been effected. The case may be made even more startling if I state that, at the time I myself entered the army there were dying *of Consumption alone* more men in *two* years than now die from all causes whatsoever in *three!*

The next remarkable war in which we were engaged was the Indian Mutiny, which broke out in the spring of 1857, and found us at grips with both Persia and China. The scenes of that terrible epoch are painful to dwell on, even at this distance of time, and only those who can remember the sensation caused in this country by those events can have any apprecia-

tion of the appalling effect they produced. The usefulness or not of the Crimean War has been much discussed, but it was undoubtedly a good thing for us that peace with Russia had been secured a year before the Indian Mutiny, so as to leave us untrammelled in our struggle with the mutineers. The results of that struggle are well known; the rising was quelled, which was indeed a foregone conclusion; the rule of our eastern empire was definitively transferred to the Crown; whilst various changes and re-organisations were made, both civil and military, having for their end the better Government and administration of that vast dependency. But there was another result. The attention of the public was called to the sanitary conditions under which our troops served, and a Royal Commission was appointed to inquire into the matter. The report and evidence was contained in two ponderous tomes, of which a good many copies still exist, although the greater part of the impression was destroyed by fire. There were not wanting good-natured people who hinted that the destruction was not entirely accidental, seeing that the report told too many truths, which it was inconvenient (from the official point of view) that the public should know. We may put such accusations by as being more than absurd, although the truths contained in the report were startling enough. But they had been known and commented upon before by the Medical Staff, too often, however, in vain. The time had now come when nothing could any longer be concealed. The country then learned the price they were paying in European lives for holding India—viz., a death-rate, excluding those killed in action and those who died of wounds, of 69 per 1,000, or a total inefficiency of at least 10 per cent. per annum from death and invaliding, and another 10 per cent., constantly inefficient from sickness, requiring treatment in hospital. Had this existed in the present day the state of things would have been as follows:—The strength of our European army is 56,000; at 69 per 1,000 the deaths would be 3,864, and the annual loss, including invalids, would be 5,600 men, whilst the loss of service from sickness would be equivalent to 5,600 more; total inefficiency, 11,200 per annum. Now, what are the facts? In 1883 the deaths were only 676, or about one-sixth of the above number, and the total losses from death and invaliding, 1,351 instead of 5,600. The number constantly sick was 3,598 instead of 5,600, although in all probability I have under-estimated the older numbers, the returns being somewhat defective. The total inefficiency now is, therefore, barely 5,000, against 11,200, or a clear gain of over 6,000 men per annum. How has this been brought about? Simply by an increased attention to the ordinary principles of hygiene. In former days there

was a convenient popular plan of accounting for disease and mortality by referring everything to the "climate," a plan equally convenient for concealing the neglect and errors of the authorities responsible for the health of the troops, and for excusing and condoning the personal imprudence and excesses of both officers and men. There is a story often told of an Irish M.P., who stated the case in a graphic and forcible way, although with a somewhat egregious bull. He said, "Men go out to India, and eat heartily and drink brandy and water, and get fever and die, and then they write home and say it was the climate that killed them!" The truth is climate was talked about in a more or less glib and dogmatic way, whilst there was hardly a person who could have explained what climate meant if they had been asked to do so. Even to-day most people would be extremely puzzled to give even a plausible definition of it. It is one of the most complex influences in existence. It is made up of questions of temperature, humidity, pressure, velocity and direction of wind, nature of soil, conformation of surface, presence or absence and kind of vegetation, proximity to the sea or to great continents, electrical influences, presence or absence of malaria, and probably scores of other things of an obscure or unknown nature. Its variation is practically infinite, and the integration of its many factors well-nigh impossible. No wonder it was credited with all sorts of malign effects upon the human constitution, all the more believed in because they could not be understood—in fact, it became a fetish, and was worshipped as such. It was one of the great functions of the commission to examine into this mysterious superstition, and once for all to shatter the idol that had done so much evil. The commission showed that so many unhygienic conditions existed that it was idle to talk of the influence of climate until those were dealt with and removed. In fact climate, *plus* all sorts of unhealthy factors, had had its day, and it was high time that hygiene should have hers, and see whether she or climate was to win in the struggle. The result has fully justified the anticipations. India is now more healthy than service at home was thirty years ago, and it has been clearly demonstrated that, other things being equal, climatic influences stand for remarkably little in affecting the health, compared with the inordinate importance attached to it but a short time ago. "Acclimatisation" is shown to be more or less a mere notion, at least in the interpretation hitherto given to it; and it is now recognised that there is hardly a corner of the earth where man cannot maintain health and energy, if his mode of life be conducted on hygienic principles. There are, no doubt, influences of locality, such as malaria,

but even those can be combated, apart from such direct methods as drainage and the like, by cultivating the resisting power of man's own constitution by a course of true hygienic living. In India were found the same evils as at home—unwholesome, badly-ventilated dormitories, unsuitable clothing and unlimited rum, not to speak of impure water, bad conservancy arrangements, and absence of occupation, every factor being aggravated by high temperature and malarious poisoning.

Much of this has now been changed, excepting of course the so-called climatic influences, which remain the same as in 1800, and the result is we have a death-rate of 12 per 1000 (in 1883), instead of 69 as formerly; the average for the last ten years being less than 18, or under the home rate of thirty years ago. There is still much to be done, for even these rates are too high, but the past gives great hope for the future: "There is always "a *yet* in each *hereafter*."

Let me cite another instructive instance, although on a less important scale, I mean the experiences of our troops in the West Indies. Those beautiful islands, which might have been an earthly paradise, were looked upon for years as a perfect charnel-house. To be ordered to the West Indies was a punishment that was little less than sentence of death, for the chances of life were small at the best, and then there was no regular relief of troops as there is at the present time. Fevers, dysentery and other diseases, with periodical outbreaks of yellow fever, and, in later times, of cholera, were among the fatal causes of the exceptional mortality. Here again of course the climate got the chief blame. But what were the real facts? The barracks were placed on unhealthy sites, the accommodation in the dormitories would have been disgraceful even in a cold climate, the rations were almost invariably salt meat, the use of fruits and vegetables was discouraged if not forbidden, the drinking water was often foul and impure, and the rum practically unrestricted. Of the accommodation in barracks I may cite the words of Sir Alex. Tulloch: "A barrack at Tobago, the best in the whole Windward and Leeward command, had the following dimensions in 1826: superficial space per man, 22½ ft.; breadth, 23 ins.; cubic space, 250 ft." "The men," says Dr. Parkes, "slept in hammocks touching each other. In these barracks, crowded as no barracks were even in the coldest climates, there was not a single ventilating opening, except the doors and windows. With this condition of atmosphere, it is impossible not to bring into connection the extraordinary amount of phthisis which prevailed in the soft and equable climate of the West Indies. There was more phthisis than in England, far more than in Canada." Soon after this some improvements took place, and

we find in Dr. Balfour's abstract, published in 1862, a comparative table of death rates, from which it appears that the mean death rate in Jamaica previous to 1836 was 128 per 1000 (rising sometimes to 307), whilst between 1837 and 1855 it had fallen to 50·8, still an inordinate figure, but a great improvement upon former times. In the Windward and Leeward command, the fall had been from 81·5 to 62·5. At present, just thirty years later, the rate is only one-fourth of this improved rate, a mean of 15.76, and an actual ratio in 1883 of only 14·44. Some of the individual items are particularly instructive. Thus *fevers* killed in Jamaica before 1837, no less than 101·9 per 1000, after 1837, only 36·9. In the present day in the West Indies the ratio for ten years, 1873–82, even including yellow fever outbreaks, is 9·30 per 1000 per annum,* and for 1883, only 8.42. Consumption killed 10·4 per 1000 before 1837, and 8·6 after that year; the deaths in 1883 were only 1·2, and the mean of the four previous years only 0·57. Even including invaliding, we have a loss of only 6 in 1883, and under 3 as an average of previous years. The number of troops kept in the West Indies is now small as compared with former years, but the above will show what a modest part so-called "climatic conditions" play as a factor in mortality. Many years ago the present Director-General of the Medical Staff, Sir Thomas Crawford, K.C.B., in a very able paper in Vol. II. of the "Army Medical Reports," drew up a table of disease factors from his experience at Secunderabad, with reference to zymotic diseases, in which he tried to apportion to each its percentage of numerical importance. Thus, taking all the factors together to value 100, those which were due to errors beyond the control of the individual, but remediable by the authorities, were taken to value 35; personal errors under the control of the individual himself, 34; agencies undefined and contingencies, 6; peculiarities of climate, 25; so that 69 per cent. was recognised as distinctly remediable, and only 25 as due to climate. This was quarter of a century ago; I think that in the present day climate would figure for even a smaller amount. It is true that there are some pestilential spots, such as the West Coast of Africa, which are especially dangerous to life, although even there preventive measures are capable of largely mitigating the danger. But, putting these on one side provisionally, we may confidently say that there is not a spot on the globe, where men may not be kept in health and vigour by proper attention to hygiene.

* Omitting 1881, a year of yellow fever epidemic, the average is only 5 per 1000.

These, then, are some of the advantages derived from the dire struggles into which we have been plunged, struggles which taught us lessons by which we have profited in the field, so that the subsequent minor wars we have waged have been carried out with a much smaller expenditure of life and health than has ever before been known in the history of the world.

I have dwelt somewhat upon the military aspect of this great question, partly because I have been myself intimately connected with it for more than thirty years, but still more because of the interest attached to it, both historically and practically. In the public service we have to deal with bodies of men whose history is known, whose ways of life are so far uniform, and who are, therefore, more distinct and definite objects of observation than can be the case in civil life. From the experience thus gained all have profited, as could easily be shown in much more detail than the scope of such an address as the present would properly warrant.

The period that I have been considering between the two Hygienic Congresses at Brussels, in 1853 and 1876, was fruitful of sanitary legislation at home, and in 1875 the Public Health Act was passed, an attempt to consolidate legislation on the subject, which, with all its imperfections, was a successful one, and forms a sound basis for future work. The passing of that important Act made it, on the whole, easier to start an Institution like ours than it could otherwise have been, the more so that its foundation coincided with the second Brussels Congress, destined to be the first of an important series of International Meetings which have since taken place biennially at Paris, Turin, Geneva, and The Hague. We may hope that before many years are over London may be chosen as its place of meeting, the only wonder being that this has not taken place before now, considering the prominent part this country has played in modern sanitation.

Important as such International Congresses are, seeing that they afford opportunities for bringing before the representatives of different countries large questions affecting the sanitation of the world, as well as that of individual states, it was felt that there was still room for more limited meetings at home, by which practical questions might be popularised and the whole system of hygiene made familiar to the people. The subject is one that requires to be presented as often and in as simple a form as possible, so that it may make an impression on the popular mind, in order that legislation may carry it along with it. For it is little or no use legislating too far ahead of the knowledge or feeling of the people. For this purpose our Institute started a series of Autumn Congresses in different

parts of the country, in connection in each case with an Exhibition of Sanitary Appliances, so that practical illustrations might be provided of the principles enunciated at the lectures and addresses or in the sections. Our first Congress was at Leamington in 1877, and that was followed by others at Stafford, Croydon, Exeter, Newcastle, Glasgow, and Dublin. The only blank year was 1881, when the International Medical Congress in London, and the great Medical and Sanitary Exhibition at South Kensington, seemed to render an additional Congress and Exhibition a doubtful success. The fact that the International Health Exhibition of last year in no way interfered with the success of our meeting in Dublin, but rather strengthened it, is, I take it, a proof of the increasing interest in the subject which even in this short interval of time has been evinced. After meeting two years in the sister kingdoms we have now returned to the heart of England itself, where, I doubt not, our labours will be crowned with a success not inferior to that of any former occasion. You will have the advantage of hearing lectures from Mr. Ernest Hart and Captain Douglas Galton, C.B., as well as addresses from the presidents of sections, in which capacity we have had the advantage of securing the services of such men as Professor Ransome, Mr. Gordon Smith, and Dr. Marcet, representative names which would of themselves secure the success of our meeting.

The Institute, however, has not considered that the arrangement of annual meetings like this has been sufficient for the work before it. Meetings and addresses have been given from time to time in London, and we hope that the time is not far distant when something like a school may be established, with a staff of teachers, laboratories, museum, &c. For this purpose it will be necessary to gather together into one centre the scattered efforts which are being made in the same direction, but which are at present, from want of union, somewhat dissipating energy in an unproductive way. Let us take the motto of the kingdom which initiated Hygienic Congresses: "L'Union fait la Force." The Sanitary Institute finds its complement especially in the Parkes Museum, with which it is already in somewhat close connection; and we hope soon to be able to make the union permanent, so that a really great central institution may be formed, which shall be a centre of instruction, and sufficiently powerful to make its views and opinions heard and respected by the State and among the people. In the meantime, the Sanitary Institute is doing an important work in offering certificates of competency, on passing examinations, to those officials who are entrusted with the carrying out of local sanitary work, I mean surveyors and inspectors

of nuisances. It is a remarkable fact that at present there is no official recognition of the competency, or the necessity for the competency, of any of the officers connected with sanitary work. The medical officer of health, the local surveyor, and the inspector of nuisances may, each and all, be appointed without showing any proof of sanitary knowledge, and are indeed sometimes appointed without the possession of it. To remedy this, the universities and other corporations, granting diplomas in medicine, offer certificates of proficiency to medical men who are on the Register and who can pass the prescribed examination. Those certificates are not yet rendered compulsory, but we trust they may be so ere long. Until, however, the Sanitary Institute stepped forward there was no similar means applicable to the local surveyors or inspectors; but now for a number of years past periodical examinations have been held, and the increasing number of candidates has shown the growing appreciation of the value of the certificates offered. As to the necessity of them I can vouch personally, for I have been for a number of years an examiner, both of this Institute, and also of other public bodies granting certificates to medical officers, and in all the different classes of candidates ignorance has been displayed, by some at least, to a degree that would be surprising to those inexperienced in such matters. It is, however, eminently satisfactory to note the progress that is being made, both in the better preparation that the candidates bring to the examinations, and in the fewer numbers that we feel compelled to reject. We earnestly hope that the time is not long distant, when it will be compulsory on all sanitary officials to show undoubted proof of their competency for office, before being entrusted with the health of the people, and the expenditure of their money. There is, however, another point in which reform is required, and that is the appointment and tenure of office of medical officers of health. Whilst we ought to insist upon their giving proofs of their competency, we must make their posts such as would be worth holding by men of special knowledge and training. The present system of uncertain tenure must be abolished, as well as the practice of appointing men in medical practice to small districts at a nominal salary. The country must be divided into large combination districts, so as to be sufficient to occupy the entire available time of a competent medical officer, who should be well paid, and irremovable except by the Local Government Board, on good cause shown and ample inquiry. There is no more reason why the medical officer of health should be under the control of local bodies than the county court judge, or any other similar official. That these and other changes will be brought about in time I

have no doubt, but at present our sanitary work is in a tentative and inchoate state, although progressive experience is gradually showing the direction in which alterations should go. The importance of the Health Department of the State is becoming more and more evident, and the success which has attended its labours up to the present time demonstrates the propriety of advancing its position to that of one of the great Departments of Government. We have even now, in the office of the President of the Local Government Board a *quasi* minister of health, but as sanitary knowlege progresses the position must be vastly increased in power and in importance.

The advantages of *unity* in administration, both as a question of efficiency and of expense, have been much dwelt upon by our friend and veteran sanitarian, Mr. Edwin Chadwick. There can be no question that a more uniform and united system would greatly add to the efficiency and materially diminish the expense of sanitary work. But the apparent outlay is not all, for the indirect expense produced by inefficiency is vastly greater than any direct outlay likely to be incurred, however extravagant. A premature death is reckoned overhead as a loss of £100, and if it is the head of the house and the breadwinner, it is evidently much more. If we double this estimate it will be less than the probable coincident damage, due to the loss of time from the proportionate amount of sickness which each death represents. There are about 750,000 deaths every year in the United Kingdom, about one-half of which are deaths of children, or of persons in the unproductive periods of life, if the remainder, pretty nearly one-third are distinctly preventible. Could those deaths be prevented we should save (on the above calculation) a sum of 25 millions per annum, or little short of the amount we pay yearly for the interest of the National Debt. Other calculations have brought out even higher figures, but they all agree in one thing, viz., that we are, as a nation, paying yearly an enormous sum for our sanitary shortcomings, a sum undoubtedly less than we used to pay, but still very large, a sum, too, that would rapidly increase if our vigilance were in any way relaxed. It is the aim and object of sanitation to reduce and, if possible, to extinguish this gigantic burden, which represents about one-sixteenth of the entire taxable income of the Country. But even this is not all, for besides the immediate losses from sickness and mortality, we have the remoter effects in weakened health and enfeebled offspring, every lowering of the health standard preparing a fertile soil for future disease and the perpetuation of the scourges of humanity. We may, however, take comfort from the good results that have arisen from such united effort as has already been put

forth, and we may congratulate ourselves on the progressing diminishing mortality generally, and the control which has been established over some of our most virulent diseases. Much, of course, is due to the increasing well-being of the poorer classes, in spite of the outcry about depression of trade. Such ebbs and flows are inevitable, but on the whole the people generally, are better off now than they have ever been, at any rate within any period of which we have trustworthy records. It has sometimes been said that the rural population were better off in former times when the population was less. In some particulars this may be the case, but I think on the whole the balance is in favour of the present day. If I should be wrong in this view, then it only strengthens the other part of the argument, viz., that the sanitary efforts of modern time have been even more productive of benefit than they seem to have been at first sight. Our statistics before this century are very imperfect, but it has been shown by comparison of the bills of mortality that the death-rate in the metropolis in the 17th century was between 70 and 80 per 1,000 per annum; in the 18th century it fell to about 50, and towards the end of the century to about 30. At the time of the commencement of systematic registration about 50 years ago, the death-rate was more than 25 per 1,000 (actually 29·55 in 1838, and 25·63 as the average of 5 years, viz., 1838-42), whereas the whole of England was only 22·60 in 1838, and 22·02 of the five years, 1838-42. Quarter of a century later the rates were—for London, 22·6; for England and Wales, 21·7; and the great towns, 23·4. London was therefore healthier than the average of the other great towns, and only 5 per cent. behind all England and Wales, whilst in the earlier period it was 17 per cent. behind, and in 1838, 33 per cent. behind the country generally. In the later returns the figures are even more satisfactory, the London death-rate being only 21, or about the same as that of the country generally. We must remember also that this improvement has taken place with a progressively increasing number of persons in the area concerned, even although the area is also continually extending. In 1831 there were less than 44 persons to an acre in the metropolis, and in 1841 just under 46. In 1883 there were 52·5, and at present probably over 54. In 1883 the area per head was only 92·2 square yards, and the proximity, or distance from person to person, if equally distributed over the area, was 10¼ yards, or nearly 31 feet. At the present time it is probably not more than 10 yards or 30 feet. Now, Dr. Farr, has made some remarks on the mean duration of life, which may be useful as a means of comparison. He has shown that the mean duration was very nearly equal to a formula which may be most

simply stated as the sum of two-thirds of the reciprocal of the death-rate, and one-third of the reciprocal of the birth-rate. Stated thus the mean duration of life in England and Wales is now about 41 years, and that of the metropolis is very nearly the same. Of course, a general statement like this includes extremes—for instance, in St. George's-in-the-East, the most crowded district, the mean duration of life is only 28, whilst it is double that in Kensington or Hampstead. Again in Liverpool, our most crowded City, it is 34, and the same in Manchester, whilst it is 48 in Bradford, and 47 at Bristol, and 44 here at Leicester. But to determine the relative healthiness we may apply another test derived also from a formula of Dr. Farr's. If we take the whole of England and Wales we find that there is a little under 1½ acres for each person, which gives a proximity of 91 yards or 273 feet. Then for every other proximity we may find the probable mean duration of life by multiplying the rate for England and Wales by a factor consisting of the proximity of the new district divided by the proximity of England and Wales, the fraction being first raised to the 0·24 power. Now, the rate for all England and Wales being 41, we find that, if conditions were equal, the crowding in our towns and cities would produce the following rates:—

	Proximity	Calculated Mean Duration of Life.	Actual Mean Duration of Life.	Difference.
London	10 yards.	24 years.	41 years.	+ 17 years.
Liverpool	6¾ ...	22 ...	34 ...	+ 12
Manchester	8 ...	23 ...	34 ...	+ 11
Bradford	16½ ...	27 ...	48 ...	+ 21
Bristol	10¾ ...	24½ ...	47 ...	+ 22½
Leicester	11 ...	24¾ ...	44 ...	+ 19¼

and, of course, worse rates in the most crowded parts. Thus in St George's-in-the-East, London, where the proximity is about 5 yards, the rate would be only 20, whereas by the other calculation it is 28, or a balance in its favour of 8 years. We thus see that in spite of many shortcomings, the health of our towns is better than might have been expected from the crowding together of so many people on a limited area. On the other hand, if we were to reverse the formula and calculate out the proportionate duration of life in the whole country from the data of, say, that of London, we should find that it ought to be 69½ years; from the Liverpool data, 63½; from Manchester, 61; from Bradford, 72⅓; from Bristol, 78½; and from Leicester, 73. We should thus be getting very near the rates of Dr. Richardson's Hygeia or Salutland; such rates are not at all impossible, although they may be remote. Thus most sanitarians agree

that the death-rate is capable of being reduced to 15 per 1,000 by the reduction of preventible disease. In that case the mean duration of life would be fifty-four years instead of 41; whilst a reduction to 12 per 1,000 would raise the mean duration of life to 65; 11 would raise it to 70; whilst a ratio of 8 per 1,000—a rate seriously contemplated by Mr. Chadwick—would bring it up to 93, and a fractional amount below 8, would establish the ideal 100 years, which is now held to be the normal life of man. To return, however, to our comparison of the duration of life, we find one or more of several possible inferences: (1) The formula may not be sufficiently general in its application to give trustworthy results; undoubtedly its application is to some extent limited, but still it is an approximation which may be used with some confidence, except in remarkable and improbable extremes. (2) The comparison shows that crowding together in an area, at least within certain limits, is not necessarily a danger *per se*, but only becomes so when accompanied with sanitary neglect. It is so obviously requisite, in a populous area, that sanitary measures should be carried out for the public benefit, that there is better chance of their being so with some stringency than in a scattered district. (3) The greater unity of action and possession of more ample powers in concentrated communities tend markedly to improve sanitary conditions, and this forms a strong argument for making the powers of local authorities equal throughout the country, and for abolishing the distinction between urban and rural districts. On this part of the question, however, I do not propose to dwell further, as I believe this important subject will be brought before you later on by a speaker who is eminently qualified to deal with it, Mr. Ernest Hart.

I have spoken hitherto chiefly of general death-rates, but these, although valuable, are less sure marks of improved sanitation than particular death rates, and more especially those from particular classes. The three most significant are: (1) the deaths of children; (2) the deaths from consumption; and (3) those from zymotic disease. They are the most significant because they are the most preventible by hygienic measures. It will be impossible to do more than say a few words about each. (1) As regards the death rate of young children: the large preponderance of their deaths is still a blot upon our social system, and I am sorry to see that Leicester has an unfortunate notoriety in this direction. For almost all zymotic diseases children form the most sensitive barometers. and they are generally the first to show symptoms of derangement if insanitary conditions are present. One of the most constant of children's disorders is diarrhœa, with which is

associated typhoid fever, often returned formerly as infantile remittent fever. This diarrhœa is partly due to insufficient and improper feeding, but it is also largely dependent upon insanitary conditions connected with bad drainage and impure water supply. As I see from the registrar-general's returns, this cause of mortality is greatly prevalent in Leicester. We shall be interested to know the particulars from those whose local experience may be able to throw light on the subject. Other children's diseases, which are believed to be dependent upon special contagion, such as measles, scarlet fever, whooping-cough, &c., are also greatly influenced by unhygienic conditions, and to some extent their greater or less rapidity of spread is an index of good or bad sanitation, although we may not at present be able to explain many of the apparently capricious phenomena which start up from time to time. Some of those curiosities of infection, as we may call them, are dependent on individual idiosyncrasy, about which at present we are almost entirely ignorant.

(2). The second group of importance is that of consumption, the disease of all others most constantly fatal, if we except diseases of the lungs and air-passages other than consumption; about 18 per cent. of all deaths are due to diseases of the respiratory system generally, and about 10 per cent. to consumption. In later years the ratio has somewhat diminished, and that fairly steadily.

In 1850-4	the consumptive deaths	were	12·6 %	of the	total deaths.
„ 1855-9	„	„	12·0	„	„
„ 1860-4	„	„	11·5	„	„
„ 1865-9	„	„	11·1	„	„
„ 1870-4	„	„	10·4	„	„
„ 1875-8	„	„	10·0	„	„
In the 25 years 1850-74		„	11·5	„	„
In 1881	„	„	9·6	„	„

From the beginning of this period the proportion has diminished more than one-fifth, or from 12·6 per cent. of total deaths to 9·8 per cent., a diminution actually of 22 per cent., the number of deaths per 1,000 being also smaller. For the twenty years, 1850-69, the average death-rate from consumption was 2·64 per 1,000 living. In the ten years following it was only 2·22, or a diminution about 16 per cent. Now what are the causes of consumption? Three main causes have been assigned, viz.: (1) Hereditary pre-disposition; (2) Faulty nutrition; and (3) Impure air. I do not propose to discuss the *first* cause, partly because it is too difficult a question to treat of in the time at our disposal, and partly because it is less directly

connected with the immediate subject on hand. I would only say that the fact of hereditary pre-disposition is pretty generally recognised, and that it is only by improved sanitary conditions that there seems any chance of mitigating or extinguishing it. Of the *second* cause much has been written; and there can be no doubt of the fact that faulty nutrition is a very important factor. Indeed, one physician attributed consumption to the high price of butter in England, and the success which has attended the administration of additional digestible fat, in the form of cod-liver oil, is a proof so far of the correctness of the opinion. But the most important factor of all is undoubtedly the *third*, namely, impure air, the rebreathing of air already charged with the impurities of respiration and transpiration. Such impurity appears especially to favour the growth of the bacillus which has been shown to be the probable active agent. I think we may therefore justly infer that the diminution in consumptive complaints is due to the improvement in the well-being of the community, and the better housing of the poor. Consumption, however, is a disease of the rich as well as of the poor, and in the case of the former it has been largely favoured, if not caused, by their being too well housed, in the sense that there has been too great a barrier between their living and sleeping rooms and the external air. The best security against the development or propagation of the disease is free ventilation, and the avoidance of course of chilling draughts. On this subject the experience of the army is very instructive. Before the Crimean War the annual death-rate of the army at home was 18 per 1,000, and of these deaths nearly 8 or 44 per cent. were from consumption. But this did not represent all, for some men were invalided, who died as civilians, and if we add these, we should have a loss of at least 100 per cent. more. This would bring the loss up to at least 16 per 1,000 from consumption alone. The data, however, are imperfect. The Royal Commission of 1857 showed clearly that this inordinate amount of disease was due chiefly to the bad ventilation of the dormitories, and steps were taken to remedy this as soon as was practicable. Accordingly, in 1861 the consumptive deaths were only 3·1 per 1,000, and the invaliding about 8 per 1,000, or a total loss of 11 per 1,000. In 1883, our latest information, we find that the deaths were only 1·72, and loss by invaliding 3·47 per 1,000, or a total loss of 4·19 per 1,000. In the same year the total deaths from all causes of disease were only 5·28 per 1,000—one-third less than the deaths from consumption alone thirty years ago. But satisfactory as the results of sanitation have been, we are not at all entitled, nor are we inclined, to rest and be thankful. We have still before us the

fact that our consumptive death-rate among the troops is excessive. I have already shown that the total loss (including deaths and invaliding) amounts to over 4 per 1,000, and accounts for rather more than one-half of the total loss by deaths in the army and invaliding for consumption. Now, in civil life, among men of soldiers' ages, we find that the deaths from consumption are under 3 per 1,000 (2·94) as against over 4 (4·19) in the army, including the invalided in the latter, which in most cases are ultimately deaths. These deaths are included in the civil total, the figures of which are not appreciably altered thereby; but they must be reckoned against the army to make a fair comparison. Now the most unhealthy districts of England show a death-rate (at the ages referred to) of only 5 per 1,000, whilst the most healthy show less than 2. We are therefore losing in the army, from consumption, 115 per cent. more than the healthiest districts of England; we are losing 43 per cent. more than the general average; and we are losing only 16 per cent. less than the most unhealthy districts, the ages and sex being the same in both cases. Nor is this all, for we have losses from diseases of the respiratory system which are largely due to the same causes as consumption, notably, insufficient ventilation. Our ratio of loss and invaliding amounts to 2·2 per 1,000 per annum—a much larger proportion than in civil life. Thus, from consumption and diseases of the respiratory system, we reckon just one-fourth of our total annual loss. Now, I have no hesitation in saying that this is largely due to the insufficiency of ventilation which still exists, and also in part to the insufficiency of the rations issued, particularly to young soldiers. The power of resistance to disease influences is thus diminished, and many men succumb who might undoubtedly be saved. Of course this cannot be remedied without additional outlay, but it would be a wise economy in the long run, and a benefit both to the individual soldier and to the state.

The *third* group of importance is that of *Fevers*. And here we are met with some difficulties in making comparison with the older statistics, in which the different kinds of fevers are less clearly defined. Under this head there are three distinct forms, viz:—Relapsing or Famine fever, Typhus fever, and Enteric or Typhoid fever, besides an anomalous class called Common Continued Fever, which will probably diminish or disappear as diagnosis becomes more accurate. Relapsing fever, the old Synocha, is not common now in this country, depending as it does mainly on actual starvation, but it was very common in former days, and in particular in Ireland during the terrible famine period forty years ago. Typhus fever, also called

spotted fever, putrid fever, jail fever, &c., was only too common when I began to study the profession. It is a disease connected with destitution, crowding together, and dirt. Once started, however, it is capable of being communicated by direct contagion in a very rapid and fatal manner, and this by individuals not themselves the subjects of the disease, as witness the story of the Black Assizes at Oxford. It is looked upon as the most contagious of all known diseases, but fortunately its contagion does not spread far. It is most completely amenable to Hygienic measures, for it is generally sufficient merely to scatter the population and allow free aëration to put a stop to it. Accordingly it has now become very rare in England, although we have occasional small outbreaks in crowded cities, such as Liverpool and Dublin, when there is much poverty and wretchedness. But a much more important disease is Enteric or Typhoid fever, which was up to 40 years ago confounded with Typhus (and is still called Abdominal Typhus on the Continent). By the labours of Stewart, Jenner, and others it was definitively separated, but continued to be merged in the group of fevers by the Registrar-General until the year 1869. This disease, we now know, owes its origin to a very different cause from true Typhus, being a disease connected with bad drainage or insufficient removal of excreta. It turns up in all parts of the world and harasses troops whenever they are gathered together. Its presence is a very sure indicator of insanitary conditions. It attacks the young by preference, although the old are not entirely exempt from it, and it is as much a disease of the palace as of the hovel. If we take the group of continued fevers and compare the statistics at different times we shall find the following results:—

In 1842, taking the male population of England and Wales at the ages of 15 to 35, we find the total deaths to be 8·4 per 1000, the fever deaths 1·09 per 1,000, and the ratio of fever deaths to total 12·4 per cent.

In 1855, the total death-rate was 7·6, the fever deaths 0·675, and the ratio of fever deaths to total 8·9 per cent.

In 1881, the total death-rate was 6·55, the fever deaths 0·356, and the ratio of fever deaths to total 5·1 per cent.

Thus the fever rate in 1855 was 38 per cent. less than in 1842, and that in 1881 was 47 per cent. less than in 1855 and 67 per cent. less than in 1842. The proportion to total deaths was 28 per cent. less in 1855 than 1842, whilst in 1881 it was 43 per cent. less than in 1855, and 67 per cent. less than in 1842. Much of this diminution is no doubt due to diminished Typhus and simple continued fever, the improvement following very much on the same lines as that

which has apparently diminished consumption. But we shall find a sensible diminution in the Enteric rate above, for in 1869, the first year in which it was separated, we find that the deaths were 390 per million living, whereas in 1881 there were only 212, a fall of 46 per cent. or 44 per cent. if we allow for the former erroneous return of cases among children as remittent fever. Now this improvement means emphatically improved drainage and excreta removal, but the fact that we still lose some five or six thousand lives per annum in England and Wales alone, shows how much still remains to be done.

In the army we formerly suffered much from fever even at home; 40 years ago the deaths were 2·4 per 1,000, and they formed 14 per cent. of the total deaths. In 1860 the number fell to about one-fourth, only 0·64 against 2·4, and 6·4 per cent. of the total deaths against 14. In 1883 the numbers had still further fallen to 0·25 per 1,000, (0·24 Enteric), and the ratio to total deaths 4·1 per cent., or taking Enteric alone 3·9 per cent. This compares favourably with the civil returns of males at the same ages, among whom the ratio is 0·301 per 1,000, or 25 per cent. higher than the army ratio. The proportion of fever deaths (Enteric) to total deaths is almost the same, viz:—4·12. Now, this gratifying improvement can be distinctly traced to two main things, viz:—improved drainage and improved water-supply; with these Enteric fever soon disappears. One satisfactory instance I may cite, viz:—that of the Royal Marine Artillery Barracks at Eastney, among the finest in the kingdom. It is 21 years since they were first occupied, during the first 14 of which they were never free from Enteric fever. In 1878 they had a very severe attack, which cost several lives. In conjunction with my former colleague, Professor Macdonald, now Inspector-General of Hospitals and Fleets at Plymouth, I made an inspection of the place, and we found the drains in bad order and totally unventilated, except into the dwellings by the sinks and waste-pipes. We made certain recommendations for remedying the evil, and those recommendations were at once carried out under the direction of Col. Crease. The gratifying result has been that for the last seven years up to the present time there has never been a single case of Enteric fever arising in the barracks, although the disease has been frequently present in the houses around them. The state of the Portsmouth drainage is very bad, but an improved scheme has been decided upon, and when it is carried out I think in all likelihood Enteric fever may disappear as it has already done at Eastney. But in spite of the progress already made Enteric fever still kills about 8,000 persons every year in the United Kingdom, and seriously injures many more, each case of death implying from 8 to 10

attacks, so that there still remains plenty to be done before we get rid of this scourge. Our experience also in recent campaigns shows how quickly the disease declares itself, when a number of men, especially young men, are brought together in circumstances which render good sanitation difficult, as must always be the case in war.

There is another disease, however, which carries to the public mind a much greater dread than even fever, and that is epidemic cholera, which has lately committed such ravages in Spain, and may possibly reach our shores by-and-bye. The terror which cholera inspires is due to the appalling suddenness of its invasion, as well as to its great proportionate mortality. The rate of mortality varies, being very great generally in the early part of an outbreak, and comparatively small towards the close. I have known 22 cases die out of 24 attacks, or 92 per cent., but my experience as a whole has been that about 63 per cent. die, or very nearly two out of three. Others put the rate at less, but up to the last few years it was not reckoned at less than one-half, or 50 per cent. In the recent epidemics in Italy, France, and Spain, and, I think I may also add, in Egypt, the death-rate was much less. Even in Spain it has only been one in three, whilst in France it has been still lower, sometimes only one in six. Whether this has been due to cases being returned as true cholera which would formerly have been called diarrhœa, or to a milder form of the disease, I am unable to say; perhaps both causes may be at work. Even as it is, it is bad enough, and we may get some idea of its ravages in this way. Suppose Spain to have a death-rate (normal) of 22 per 1000, about the average of this country up to recently, then she would have about 1000 deaths a day as the usual death-rate, but she has been losing from 1500 to 2000 lives from cholera alone, and altogether, up to the end of August, some 80,000 persons or more had perished in a population of 16 millions, so that the death-rate was being more than doubled. Our normal death-rate in this country is about 16,000 a week: if cholera prevailed in the same ratio as in Spain we should be losing some 25,000 a week from that cause alone, and the total death-rate would be between 40,000 and 50,000. This naturally leads us to consider what condition we are in to resist this formidable invasion. Cholera has visited Europe six times, including the present epidemic, and in 1832, 1849, 1854, and 1866, it prevailed in this country; but in 1873 and up to the present time in the existing epidemic it has not been able to make good a footing. It is chargeable, during the last 54 years, for the deaths of about 180,000 persons in the United Kingdom, or perhaps 200,000 if we add in the increased diarrhœa which

always accompanies it. This number divided by 54 years gives 3,700 a year. But in those 54 years the deaths from fever were higher in the aggregate, the enteric cases being three to four times as great and the total amount still higher. Even in epidemic years the deaths from fever sometimes equalled those from cholera; for instance, in 1854 there died in England and Wales 20,000 from cholera and 19,000 from fevers, and in 1866 there died 18,000 from cholera and 21,000 from fevers, or, in the two last epidemics the total cholera deaths were 38,000, whilst the total fever deaths were 40,000. Observe, too, that this group of fevers does not include scarlet or other eruptive fevers. Altogether, the deaths from fevers in the United Kingdom during these 54 years cannot have been less than a million and a half, or eight times the mortality due to cholera. We have thus had a constant enemy to deal with, the mere familiarity with which has bred a certain degree of contempt. On the other hand the more impressive onslaught of cholera has roused us from time to time to more vigorous action, to such an extent indeed, that we may say that cholera has been more of a blessing than a curse, and that it has saved many more lives than it has killed. The action which was found necessary on its account has been fruitful in diminishing other diseases favoured or propagated by insanitary conditions. The epidemic in the year 1849 was the most severe wave of cholera that has ever spread over the world, and the mortality of that year was the highest we have ever had. In 1854 the loss was very much less, and in 1866 it was smaller still. In 1873–5 the disease was spread over the continent of Europe, but although frequently introduced into this country, it never managed to find a foothold. And in the present time the disease has existed since 1882 in Egypt, Italy, France, and Spain, but it has not established itself here, in spite of our constant intercourse with those countries. The result is doubly interesting, because it proves on the one hand the utter futility of quarantine by land or sea, a point we have long contended for, and on the other the paramount importance of hygienic measures. Quarantine has never been practised by us since 1832, and even then it was only in a partial way. In other countries where it has been rigidly and vexatiously exercised, it has been quite inadequate to keep out the disease. In fact it has tended to foster it and to increase the danger. The truth is, it is wiser to render the soil sterile to the seed than to try vainly to keep out the seed by clumsy expedients, which are about as efficacious as if a tortoise were set to catch a butterfly. We have wisely in this country devoted our expenditure to internal sanitation, to the provision of pure water and good drainage, and such other

measures of sanitation as have been found practicable. One learned German professor thinks we have gone too far in this direction, and that we should be all the better for a little dirt in our dwellings, with a nice damp basement and a cesspool or two, to which he was inclined to attribute the immunity of some towns in Southern Europe from epidemics. I think, on the whole, however, we shall continue on our own path, remove dirt where we can, and generally wash and be clean. Judging from the past, I think we may have good hope for the future, for we are far better situated for resisting an epidemic than we ever were before. The government organisation for information of the arrival of cases of disease and for inspection is far more complete, whilst the local conditions of our towns and villages, although leaving much to be desired still, are vastly improved since 1866, and even since 1873. It is not well to boast, but I think we may look upon the progress of cholera with calmness, feeling assured that the chances of its spreading among us are but few, not only because we ourselves are better prepared, but also because improvements have been going on in other countries which have usually been the channels through which the disease has filtered towards us. I am also in strong hopes that the present cholera-wave will go far to give a death-blow to the pernicious absurdities of quarantine; in fact, the sitting of the International Conference at Rome in the spring of this year showed that our principles were spreading abroad and that quarantine has received a shake from which it is not likely ever again to recover completely. And even in Spain the government has ordered the abolition of land cordons, although the ignorance and terror of the people and of the provincial governments have in some cases led to disregard of the order.

Some interest has been excited by the asserted success of the process of inoculation as a preventive against cholera, as practised by a Dr. Ferrán. The practice is based on the supposition that the comma-bacillus of Koch is the real cause of cholera, and that by specially cultivating it a mild form of the poison may be obtained, which, when inoculated, confers immunity from the disease. Even if this were considered proved, the way in which the process has been carried out in Spain has not commended itself to the medical profession, no real scientific investigation having been made. But that the comma-bacillus is the real cause of cholera is very far from being proved as yet. There is also another difficulty—viz., that one attack of cholera does not confer immunity from another, although Dr. Cameron, M.P. for Glasgow, has striven to show the contrary in a paper in the *Nineteenth Century* of August last. The prophylactic inoculation, however, is not impossible, provided such immunity can be proved even in a partial way; and this is shown by the

success of many of Pasteur's experiments in other maladies. The theory is that by a process of cultivation a benign form of germ may be obtained which, without producing much disorder, effectually sterilises the blood of the individual towards the real morbific germ. The experience in the case of small-pox showed that even direct inoculation produced a milder form of the disease than when it was taken by infection in the ordinary way. It is possible that the mere passing from person to person may to some extent attenuate a virus, and ultimately lead to the cessation of an outbreak, although there is also the powerful factor of the exhaustion of susceptible victims. The system of small-pox inoculation was certainly a benefit to the individuals, but as furnishing fresh centres of infection it was a doubtful benefit, if not a positive evil, to the community. It is the presence of equally great protective power, combined with the absence of any power to infect short of direct inoculation, that constitutes the great value of vaccination; and Pasteur, in recognition of the value of Jenner's great discovery, has used the word as a general term to express prophylactic inoculation of any kind. I am not going to enlarge upon this subject here, but I hope opportunity may be found to discuss it in the section of preventive medicine. I take, however, this opportunity of making it distinctly understood what my views are—viz., that vaccination is one of the greatest boons ever conferred upon humanity, and in saying this I believe I express the views of the council of this Institute. This town (Leicester) has constituted itself a principal centre of opposition to vaccination, and I believe that you insist that ordinary sanitation is sufficient to prevent small-pox. With special regulations and strict isolation I believe you have been able to keep the town very free from it. I should be but a bad sanitarian if I did not recognise the value of both these measures, but I would point out that you are working now with a population that is for the most part already vaccinated. What it may be when an unvaccinated population has accumulated is a very different thing, and I fear you will have a rude awakening. It is an entire mistake to suppose that a prophylactic measure, such as vaccination, is antagonistic to general hygiene, on the contrary they go hand in hand. We are now too fully convinced of the advantages and paramount importance of general sanitation to be likely to fall so far back into error as to neglect it. The results obtained in the past are but an earnest of what may be done in the future, but our labours must be unremitting, and we must take as our motto—

"Count nothing done while ought remains to do."
Nil actum reputans dum quid superesset agendum.

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS

By Arthur Ransome, M.D., F.R.S.

PRESIDENT OF THE SECTION.

It is desirable that in its brief periodical visits to the principal cities and towns of the country, our Institute should, if possible, leave behind it some abiding and growing influence.

When I was first asked to undertake my present duties, it was my wish to conduce to this end by advocating the establishment in each town visited by the Institute, of some local sanitary association, similar to the one with which I am connected in Manchester, that has now been at work in that city for more than thirty years. If this suggestion were adopted there would then be scattered over the country permanent, and, we may hope, active associations, each of which would carry on the objects of our Institute, and that would prevent our visits from becoming merely a "three days' wonder," and their influence from quickly dying out.

There are probably few places in England that would be so likely as Leicester to benefit from the establishment of such an institution in its midst. From the Registrar-General's last annual return it appears that the mortality in Leicester of infants under five years of age was over 500 per 1000 deaths —more than one-half of the total mortality—and during the month of July the *Sanitary Record** notes no fewer than 100 deaths from diarrhœa, an eminently preventible disease.

Such a fearful mortality as this must be due to something wrong in the place itself. As Mr. Simon remarks:† "Local

* Aug., 1885, p. 72.

† Papers relating to the sanitary state of the people of England, 1858, p. 8.

excesses of fatality are due to local circumstances of aggravation," and "these aggravating local circumstances are such as it is fully possible to counteract."

Surely it behoves the inhabitants of this great town to take measures to remove such a reproach to their humanity as soon as possible. One of the best means for this purpose would be, I believe, the formation of an influential voluntary sanitary association.

I should have wished to dwell longer upon this subject, but I have been requested by your chairman, Dr. Alfred Carpenter, to treat more generally upon the subject of disease prevention, and must therefore leave this suggestion for your future consideration.

I am, however, unwilling to abandon the hope of leaving behind me some statement that may have a permanent influence upon the sanitary enterprise of this place, and as a merchant endeavours to sell his wares by offering samples and proofs of their value and efficiency, so I propose now to advocate sanitary measures by giving you a record of a few facts showing the success that has attended their application in the past.

The present time is particularly opportune for a review of this kind.

We are now probably approaching the end of an epoch in sanitary science, and as Dr. Whewell has shown* no important advance of any science ever takes place with perfectly equable steps. The epochs marked by each such advance have both a "Prelude" and a "Sequel."

At the present time, thanks to the labours of such men as Simon, Pasteur, Lister, and others, we have passed through the greater portion of the first part of the period. The careful researches of these observers have revealed to us such a knowledge of the causes of many epidemics and of some endemic diseases as will enable us to cope successfully with them in the future. But now comes the "sequel" of the epoch, and in this period, whilst we may expect the above discoveries to acquire a more perfect activity and a more complete development, a great part of our work will consist in diffusing our knowledge through a wider throng of the secondary cultivators of the science, and in tracing it into its distant consequences. This, as Dr. Whewell remarks, "is a work always of time and labour, often of difficulty and conflict."

The work of diffusing amongst the community the knowledge that has been gained is especially necessary in the case of sanitary science.

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* History of the Inductive Sciences, vol. I., p. 10.

The successful application of its principles depends to a great extent upon their willing acceptance by the people. In these times, no law, however good, can work with thorough efficiency in the face of even a small phalanx of mistaken malcontents. We have not to look far for an illustration of this fact, there are abundant indications in this locality of the "difficulty and conflict" characteristic of the period; but it is the special function of the Sanitary Institute to enter into battle with the opposing forces, and one way in which this may be done, and the one most likely to leave permanent results is to build up in the minds of the people a rampart of well-ascertained facts, that will enable them effectually to resist the battery of specious arguments that will be brought against them.

To take another analogy, and one more in harmony with our peaceful office, let us endeavour in this resting period, so to feed men's minds with facts and with the principles drawn from them, that they will be ready hereafter to put in force all the beneficent and health-giving procedures that have been provided for them by the earnest labours of so many generations of single-minded men of science.

I can do little more now than indicate one step that may be taken in this direction by the Agents of our Institute—namely, to insist constantly upon the successful results obtained by sanitary measures in the past.

It is a trite saying that men often fail to realize the blessings of health until they have lost them, but the converse of this proposition is equally true of the popular appreciation of the value of preventive medicine, for in an improved condition of public health, people easily forget the evil times through which their forefathers have passed, and hence they seldom fully realize their own present happiness.

Up to a comparatively recent period it was scarcely possible to appeal to the general rates of mortality of the country for evidence of an improvement in its sanitary condition, as Mrs. Browning says:—

> "The world we're come to late, is swollen hard
> With perished generations and their sins:
> The civiliser's spade grinds horribly
> On dead men's bones, and cannot turn up soil
> That's otherwise than fœtid."—*Aurora Leigh*, p. 52.

Thus the death-rate was apparently unchanged from decade to decade, and it was necessary to enter into details to show that some such improvement must have taken place to countervail the many other sources of mischief that had been steadily

increasing along with the increasing concentration of the population.*

These details are by no means less significant at the present time, but within the last ten years a striking change has taken place even in the general death-rates, and whoso runs may read the vindication of sanitary science. A saving of life to the extent of about three-quarters of a million of persons in a decade may now be reckoned up from the pages of the Registrar-General's returns, and, when we examine the figures that he gives, the diminution in certain classes of disease points unmistakably to the influence of measures of preventive medicine.

The following table is taken from the last annual return, and gives a comparison between the ten years 1861-70, and the three years 1881-83, and it shows that the total saving of life from the specified diseases amounts to over 60,000 annually.

The most notable improvement in these figures is in the four diseases: scarlet fever, fevers (mainly typhoid), diarrhœa and phthisis. All these complaints, with the exception of the first, have been found to be distinctly controlled by better drainage and water supply, and it is highly probable, as has been shown by Dr. Alfred Carpenter, that scarlet fever must also be classed amongst these diseases.

DEATH-RATES IN ENGLAND (PER MILLION).

	1861-70.	1881-83.	Differences.	Total Annual Saving.
Small-pox	162	68	— 94	2,444
Measles	442	369	— 73	1,898
Scarlet Fever	972	513	—459	11,934
Fevers	885	292	—593	15,418
Diphtheria	187	140	— 47	1,222
Cholera	108	13	— 95	2,470
Diarrhœa, &c.	868	601	—267	6,942
Phthisis	2488	1846	—642	16,692
Other Tuberculous Diseases	768	713	— 55	1,170
				60,190

But the case in favour of sanitation becomes still stronger if we take account of its application in special instances.

1. In the Army and Navy.—At one time—namely before the year 1854—no class of our population was apparently so unhealthy as our soldiers and sailors, when its mortality was com-

* See address on the present position of State Medicine in England: *British Medical Journal*, 1877, p. 214.

pared with that of the ordinary civil population of the country. This fact also was the more remarkable because these men had been selected from amongst these very people for their health and strength, and had all been submitted to a careful medical examination before they were enrolled. In certain army corps also they were drawn for the most part from a class above the lowest ranks of society. Her Majesty's Guards are nearly all of them not only men of the most stalwart proportions, but many of them are of birth and condition above that of the ordinary rank and file of the army, and yet at one time, as you may see from the following Table, these men died at three or four times the rate of the ordinary civil population, many of them succumbing to consumption and others to various forms of fever.

MORTALITY PER 1,000 OF STRENGTH.

	1830-37.	1837-47.	1863-72.	1874.
Househould Cavalry	14·5	11·1		
Cavalry of Line	15·3	13·5	9.17	8·79
Foot Guards	21·6	20·4		
Mediterranean Stations	21	16·4	11.2	7·27
Canada, &c.	23	17	9·49	6·0
Jamaica, &c.	91	59	17·05	16·9
Madras, India	52	—	24·22	14·22
Bengal, „	44			
Ceylon	49	—	21·95	6·04

Rates of Mortality at the same ages prevailing in healthy country populations	7·7
In England and Wales	9·2
In Manchester	12·4

The report of the Commissioners shows clearly that the chief causes of this fearful mortality were to be found in the unwholesome barracks in which these men had to live: "The dormitories or barrack rooms are very confined, the minimum cubic space allowed to each soldier by regulation being only 450 feet, and in a majority of cases even this minimum is not attained; in a number of barracks there is a deficiency of one-third, and in some instances of more than half of the space allotted by regulation." (P. 17.) "The result is that the soldier sleeps in a fœtid and unwholesome atmosphere."

One witness (Sergeant Brown) on being asked as to the state of the air of these rooms replied: "A very thick and nasty state, especially if I came in out of the air. If I went in out of my own room sometimes, I could not bear it till I had ordered

the windows to be opened to make a draught." The conclusion of the commissioners, drawn from all the facts brought before them, was that "the ravages committed in the ranks of the army by pulmonary disease are to be traced, in a great degree, to the vitiated atmosphere generated by overcrowding and deficient ventilation, and the absence of proper sewerage in barracks." (P. 16.)

Shortly after this report was issued measures were taken to remove these defects, and the result is plainly seen in the improvement that has since taken place in the health of the army (see Table)—an improvement so great that, in the Abyssinian campaign, Lord Napier of Magdala was able to conduct it to its close without the loss of a single man from disease; and in the last annual report of the Army Medical Department for 1883, we find that the deaths of soldiers in the United Kingdom were only 6·28 per 1,000, and throughout the world only 9·57 per 1,000.

The improvement in the sanitary condition of the navy is little, if at all, less manifest. We are told by Dr. Guy ("Public Health," p. 162) that "in the year 1779, 70,000 men were voted for the service of the navy; of these 28,592 were sent sick to hospital, and 1658 died. In 1813, out of just twice the number (140,000) 13,071 were sent to hospital, and 977 died. In 1779, therefore, the sick were more than 2 in every 5, and the deaths 1 in every 42; while in 1813, the sick were about 2 in 21, and the deaths 1 in 143, the sickness reduced to a fourth, the deaths to little more than a third! These figures speak for themselves; they are very eloquent."

"Is it possible," he says, "to imagine a more conclusive demonstration than these facts afford of the reality and importance of the science and art of hygiene?"

If it be true, as it undoubtedly is, that by improvements in diet, water supply, and ventilation, in clothing and cleanliness, aided by superior medical treatment, and especially by vaccination, and by an improved dicipline, tempered by mental culture and amusement; if it be true that these improvements and reforms have saved life, and prevented sickness to such an extent that the effective force of our navy has been more than doubled, that one ship, for every purpose of navigation and warfare, is at least equal to two of the same size and force, that a vessel can now keep the sea twice or thrice the time that was possible less than a century ago; if it be true that, at the old rate of mortality, all Europe could not have furnished the seamen necessary for our defence and safety during the great revolutionary war; then is it a mere waste of words to argue that health, which is the strength of all who work, is the great

source of power to nations in their peaceful labours as in their warlike struggles?"

I may bring this eloquent account up to date by saying, that in the last report of the health of the navy (for 1883) the death-rate was only 5·88 per 1000 in all, and only 4·05 from disease alone, the lowest record since the commencement of these reports, 28 years ago.

2. Prisons. Let us next inquire as to the past and present of the prisons of the country, and as to the past let Lord Macaulay speak. "In the times of the Stuarts," he says, "the prisons were hells on earth, seminaries of every crime, and of every disease. At the assizes the lean and yellow culprits brought with them from their cells to the dock an atmosphere of stench and pestilence which sometimes avenged them signally on bench, bar, and jury. But on all this misery society looked with profound indifference."

Dr. Guy, in his admirable little work on "Public Health," gives many interesting details respecting the "jail distemper," the Black Assizes at Oxford in 1577, and at Launceston in 1742, when so many persons died, including the Lord Chief Barons, sheriffs, and others, that Macaulay's account is fully justified.

He also describes the state of the prisons, and the fearful condition of their inmates drawn from Howard's statements. It must suffice to say that, "from a public inquiry, it appears that from August 1776 to March 1778, out of 632 prisoners 176 had died," much more than 1 in 4.

Contrast with this state of things the condition of prisoners at the present time. Our prisons are now models of hygienic management, and in the last report of the Medical Inspector it is stated that "the conditions under which the prisoners are placed are such as to maintain their health, and in most cases to improve it."

As Mr. Escott points out*—"The prisoner's health is carefully tended. He is continually weighed, if he falls away in flesh, or suffers from bodily ailment, he is prescribed for or admitted into hospital. His moral welfare is equally regarded."

The Secretary of State for the Home Department writes in November, 1883:—"The progressive decrease in the death-rate of the prisons, which has now reached 7·8 per 1,000 of the prison population, is a striking proof of the successful care that has been bestowed on the health of the prisoners." "Considering that the class of persons who are placed under the care of the medical officers are generally those whom vice and crime have rendered

* England, its people, polity, and pursuits, p. 251.

unhealthy subjects, this death-rate (even taking into account the number of diseased prisoners released on the score of ill-health), must be regarded as singularly low."

It will be noted that it differs very little from the rate already given of the general civil population of the country between the ages of 21 and 50, and it may be remarked that of the 17,000 prisoners 3,500 are under 21, and 1,700 are over 50.

It may possibly be objected that it is scarely fair thus to compare the England of the time of Howard the Philanthropist with that of to-day.

The neglect of the prisoners in those times was of a piece with the general neglect of sanitary matters, and was the cause of the fearful mortality. Its diminution then might be supposed to have had little to do with sanitary science properly so called; that the common sense of mankind had amended the evil before the birth of this branch of knowledge, which has only arisen in the course of the present century and most of it within the limits of the reign of our present gracious sovereign. This was not the case, however, for the improvement of prisons took its rise after the passing by the House of Commons in 1774, of an Act for Preventing the Jail Distemper.

"This Sanitary Act," says Dr. Guy, "had many of the properties of sound legislation. It is concise and clear, prescribes what is to be done, insures the requisite publicity, constitutes a body of inspectors (the Justices of the Peace in Quarter Sessions assembled), and provides a summary punishment for the infringement of its own provisions."

3. *Small-pox and Vaccination.*—There is yet another instance of the beneficial operation of a sanitary measure, as to which it is also necessary, happily for us, to travel back into the past, at least as far as the beginning of the present century, before we can fully realise the good that has been derived from it.

I speak now of vaccination, and I am the more impelled to go into some detail upon the subject because I am informed that in this town there are still to be found many persons who doubt the value of the protection it affords, and who stoutly oppose the existing laws on the subject.

It is difficult now-a-days to realize the terrible nature of small-pox. To the civilized and protected classes of society it has almost ceased to be a fatal disease. In the Table which I have given you, it will be seen that only sixty-eight persons per million died of it, and even in the great epidemic of 1871 and 1872, less than 1 in 1,000 many of them unvaccinated persons. But in the times before vaccination, as Mr. Simon tells us, "it often ravaged more fiercely than the most ruthless of human wars." "In every country, probably, its first

invasion has been of this kind, and its recurrences, when far apart, have been of equal malignity. Thus it was that in 1518, following European adventure to the western world, it concurred with fire and sword, and famine and blood-hounds, to complete the depopulation of St. Domingo; thus, that soon afterwards, in Mexico, it even surpassed the cruelties of conquest, suddenly smiting down three and a half millions of population, and leaving none to bury them; thus, that in Brazil, in the year 1563, it extirpated whole races of men; thus, that about the same period, in the single province of Quito (according to De la Condamine), it destroyed upwards of 100,000 Indians; and thus, too it has been in later days that Siberia and Kamschatka have been ravaged; thus, that again and again, till very recent times, the same dreadful pestilence has depopulated Greenland and Iceland. Before the terror of its presence, communities literally dissolved themselves, and the well-known description of the plague at Athens does not convey more dreadful images of human suffering than may be gathered from the writings of those travellers who, even to the latest times, have witnessed the power of natural small-pox against remote, unprotected populations. While such was the small-pox in the less travelled parts of the world, it seems certain that in civilized Europe, with its constant intercourse of towns and countries, the disease was at least as deadly. Its strength, indeed, was differently distributed, not—as in Greenland—twice or thrice in a century, but incessantly, that fatal sickle was in motion, and the harvest counted from day to day. Instead of coming after long absence on masses of population entirely unprotected against the infection, it recurred in each place so frequently that, for the most part, at any given moment, a more or less considerable majority of the inhabitants would have faced the danger before. They would have obtained against its attacks that protective exemption which was generally the good fortune of survivors. But it is a moderate computation, that for every five persons thus, at the price of much past suffering, almost secured against the disease, one at least must have died. The annual ravages of small-pox in Europe alone have been estimated at half a million of lives. M. De la Condamine reckoned that in France a tenth of the deaths were by small-pox; Rosen's estimate of Sweden was to the same effect. For our English experience there exist only imperfect records, but it seems that within the London bills of mortality, small-pox, when not at its worst, averaged a fourteenth of the annual total of deaths; a fourteenth, too, at times when that total, as compared with the population, represented perhaps double our present death-rate."

"Yet the ravages of small-pox are not half enumerated in the list of the myriads whom it killed." From the earliest to the latest medical records of the disease, there is constant mention of the tax which it levied upon the survivors. "Among those who outlive it" (says De la Condamine) "many either totally or partly lose their sight or hearing; many are left consumptive, weakly, sick, or maimed; many are disfigured for life by horrid scars, and become shocking objects to those who approach them." "It is scarcely needful to say of the disease I have described that it was amongst all civilised nations a constant source of terror," and "perhaps at no previous moment of English history had the horror of small-pox been greater or more fully justified than at the beginning of the last century." Let the same writer (Mr. Simon) tell us of the change produced by the practice of vaccination: "The results are truly conclusive."

Compare for instance, in the case of Sweden, the twenty-eight years before vaccination with forty years soon afterwards;—during the earlier period there used to die of small-pox, out of each million of the Swedish population, 2,050 victims annually; during the latter period, out of each million of population, the small-pox deaths have annually averaged 158."

"Or, compare two periods in Westphalia: during the years 1776-80, the small-pox death-rate was 2,643: during the thirty-five years 1816-50, it was only 114. Or taking together the three lines which belong to Bohemia, Moravia, and Austrian Silesia, you find that where formerly (1777-1806) there died 4,000, there now die 200."

"Or, taking two metropolitan cities, you find that in Copenhagen, for the half century 1751-1800, the small-pox death-rate was 3,128, but for the next half century only 286; and still better in Berlin, where, for twenty-four years preceding the general use of vaccination, the small-pox death-rate had been 3,422, for forty years subsequently it has been only 176."

"In other words, the fatality of small-pox in Copenhagen is but an eleventh of what it was; in Sweden little over a thirteenth; in Berlin and in large parts of Austria, but a twentieth; in Westphalia but a twenty-fifth. In the last named instance, there now die of small-pox but four persons, where formerly there died a hundred."

But we have not yet reached the full extent of the benefit to be derived from vaccination.

After a multitude of operations had been practised it became evident that complete immunity to subsequent attacks of small-pox had not been conferred; either from an insufficient original inoculation with the lymph, or else from a gradual fading away

of its influence, some of the vaccinated persons were found to take the disease, though usually in a modified form.

Since it was in adults, or in persons who had not been vaccinated for a number of years, that this liability to contract small-pox was mostly perceived, it was most probable that the latter explanation was the most usual one, and accordingly the practice of re-vaccinating adults was introduced. In most of the European armies all the recruits were obliged to undergo this operation, with the result that in all of them the mortality from small-pox was still further reduced.

In Germany, after the Franco-German War, when the small-pox epidemic of 1870–71 prevailed, the idea began to be entertained that still better results would have been obtained if the army had not been exposed to the increased intensity of the poison due to a surrounding population only imperfectly protected against its attack.

In this country therefore a still more stringent Vaccination Act was passed in the year 1874, making not only infantile vaccination but re-vaccination compulsory.

According to this law, "every pupil at public or private school must be vaccinated in the twelfth year of life, unless he has had ordinary small-pox within the last five years, according to medical witness, or has been successfully re-vaccinated."

The result of this enforced re-vaccination has been almost to stamp out small-pox altogether. The records of the small-pox mortality in London, Paris and Berlin respectively show that the remarkable and persistent decline of the disease since 1874, can only be due to the new vaccination law—for all other conditions in these towns remain since that date pretty nearly the same as they were before. The mortality from this cause in the general population is now reduced to 2 or 3 per 100,000 persons, and in the German Army not a single death from small-pox has taken place since the year 1874.

In the Austrian and French armies during the same period there is still a large death-rate from this cause.

The following comparison between these armies is given in the report of the German Vaccination Commission,* published at the commencement of the present year.

At the beginning of the year 1870, the armies of Prussia and Germany, as well as the united populations of these countries, had to go through an epidemic of small-pox. Accurate numerical data are lacking with regard to the French army, but it is certain that its losses also were very considerable. During

* The Report of the German Vaccination Commission is printed with the diagrams in the *British Medical Journal*, August 29th, 1885, p. 408.

the year of the war, the Prussian army had by far the fewest losses, although in France the soldiers came frequently into contact with the infected population.

The war in itself, with its hardships and deprivations, could not have increased the mortality from small-pox, for the Austrian army, in the same epidemic, suffered far greater losses from it.

The only difference with regard to the ratio of small-pox in the three armies is, that the French and Austrian army was incompletely re-vaccinated, and also inadequately vaccinated, and therefore found to be more visited by small-pox, while the Prussian army had the advantage of having re-vaccination carefully carried out, and enjoyed the protection which a neighbourhood almost free from small-pox procured for it. The prejudicial influence of a neighbourhood tainted with small-pox, and the relative protection of a neighbourhood free from it, is, however, evident from the Table of the cases in the Prussian army, given in the report referred to.

It must also be noted that re-vaccination had been already practised several times (every tenth year) in the army. Notwithstanding this, cases of small-pox were more numerous in the years 1867 to 1869, and therefore before the time of the inoculation law, than after the year 1874. For this fact there is no other explanation than that, in the same way as small-pox in the army considerably increased in consequence of the close contact with the sick in France, so, formerly, it must have been more frequent in the army, as the civil population had also more sickness from small-pox than at present. It is noteworthy that since the year 1874 no deaths from small-pox have occurred in the Prussian Army, while both the other armies still show by comparison quite a considerable mortality from this disease. No other reason can be given for such an exceedingly striking difference between the prevalence of small-pox in the three armies than the working of a strictly-carried out inoculation and re-vaccination.

I commend these facts to the attention of the anti-vaccinators of Leicester and other places, only expressing my fear that those who fail to be convinced by them are inaccessible to any argument whatever.

4. Consumption.—I have already called your attention to the remarkable reduction in the number of deaths from consumption. Hitherto this disease has not usually been classed amongst those that can be prevented by sanitary measures; it has been supposed to be mainly a matter of nutrition and of circumstances beyond the control of local authorities; but Dr. Buchanan has demonstrated the enormous ameliorating influence of drainage upon this disease. It appeared to me that it might be desirable

to ascertain what was the limit of its preventibility. I had noticed that the disease was comparatively infrequent in the place in which I myself live, and it occurred to me that I might ascertain how many cases originated in the different parts of the locality. A great portion of it is composed of deep porous soil, but it is surrounded by boulder-clay, the result of glacial drift, and a great part of Bowdon, and parts of Dunham and Altrincham, are built upon a thick bed of sand, in many places over 100 feet in thickness. The climate is thus rendered temperate and the air and soil dry. After the wettest weather the paths speedily become dry, and the basement story of a house is often as dry as its attic. It has the further advantage that it is virgin soil. The sand is as pure and free from organic matter as in the days when it was deposited by ice floes, or was silted up by the estuary of the Mersey. No house is ever built upon freshly made ground, or on pits that have been filled up with refuse. The locality is also well sewered and has a plentiful supply of good water. Moreover, the inhabitants are for the most part well-to-do people. Out of 2,559 of population at the last census, only about 500 are poor, and live on the low-lying clay lands that surround the sandy downs upon which Bowdon is built. The remainder dwell in well-built, salubrious houses, they are well fed and comfortable in their circumstances.

It will thus be seen that such a community are in a position peculiarly well fitted to preserve them from attacks of tubercular disease. I was, however, hardly prepared for the result of my inquiries.

I obtained from the superintendent registrar of deaths an extract from the death register of all the deaths from diseases of the lungs occurring in Bowdon in the ten years 1875-84.

Of these 22 were from phthisis, but 11 of them took place in the low-lying clay lands before mentioned, and 9 of the remainder were found to have contracted the disease before coming to Bowdon. This leaves two to be accounted for, and one of these was a gentleman connected with the city mission in Manchester, who was therefore constantly obliged to attend crowded evening meetings in different parts of the town. The other was a merchant's clerk, who went to town at 8 every morning, and did not return until 7 p.m. None of the female population, who are more constantly in the place, contracted the disease there.

Such a record as this is a strong testimony to the truth of the observations made by Drs. Bowditch and Buchanan, as to the influence of a well drained porous soil upon the disease, and it holds out to us the hope that when further attention is paid to this point, a large part of the terrible mortality that still

takes place from this disease may be prevented, and that consumption may cease to be as it has been called 'the scourge of the English people.'

I have now passed in review the success that has attended sanitary effort in diminishing the general mortality of the country, especially that from such diseases as scarlet and other fevers, from small-pox, and from consumption. I have also shown its influence in the special cases of the mortality in the army and navy, and in our prisons.

We are still far from having reached the full extent of the benefits that may be derived from it, but we may hope by its means to bring somewhat nearer the time promised by Isaiah to those who obey God's laws, when "There shall be no more thence an infant of days, nor an old man that hath not filled his days, for the child shall die an hundred years old."—*Isaiah*, c. lxv., v. 20.

On "Infantile Diarrhœa," by Dr. W. E. Buck.

This question of Infantile Diarrhœa appeals to us especially in Leicester, as this town has been for a long series of years notorious for the excessive mortality from this cause. In dealing with this subject, I propose firstly to point out the peculiarities of the death-rate from this source, as shown by the quarterly reports of the Registrar-General; secondly, to take the positive facts; thirdly, to deal with the negative facts; fourthly, to bring before you a theory that I have long held, together with such corroborative evidence as I have obtained; and lastly, to add a few words on the pathology of what I venture to call specific diarrhœa.

The first point to be noticed in the quarterly report is that the deaths from diarrhœa are taken and multiplied by four, so as to make an annual rate per 1,000 for the third or summer quarter; this is usually known as the diarrhœa rate. According to these tables during ten years, 1874-83, Leicester is at the head of the list with 7·1, being followed by Preston 6·4, and Hull 5·0; while at the end are Bristol 1·7, Huddersfield 1·6. and Halifax 0·9. These are all commercial and manufacturing towns, and yet they constantly occupy the same relative positions in the diarrhœal rate.

Average annual death-rate from diarrhœa in summer quarters of 10 years—1874-83:—

Leicester	7·1	Wolverhampton	3·0
Preston	6·4	Blackburn	2·9
Hull	5·0	Bradford	2·8
Salford	4·7	Portsmouth	2·7
Leeds	4·5	Brighton	2·6
Birmingham	4·2	Derby	2·5
Sheffield	4·0	London	2·4
Bolton	3·9	Cardiff	2·4
Liverpool	3·8	Plymouth	2·1
Manchester	3·5	Oldham	1·9
Sunderland	3·4	Birkenhead	1·8
Norwich	3·4	Bristol	1·7
Newcastle-on-Tyne	3·1	Huddersfield	1·6
Nottingham	3·0	Halifax	0·9

Mr. Vacher, in an able paper, says that the returns of the Registrar-General are not accurate. Well, no statistics, I suppose, are absolutely and infallibly accurate, and death returns are subject to disturbing influences. Many a death from delirium tremens or from hereditary syphilis is registered under some more respectable head; there are occasional misleading certificates given in order to secure insurance money; and even the best of men may make mistakes in diagnosis. But these influences are the same in all towns; and though the returns may not be strictly accurate, I think we may assume them to be relatively so, and may fairly use them for purposes of comparison. A still more important point made by Mr. Vacher, and one that may be fittingly discussed here, is whether this diarrhœa is one or many diseases, or whether it is merely the symptom of a disease.

Now, I freely grant that diarrhœa occurs as a symptom of many chronic and wasting diseases, but the deaths from these take place all the year round, and are not the cases which swell the rates at Leicester, Preston, and Hull. They probably occur nearly equally in every large town in the kingdom. If this diarrhœa were simply symptomatic, the death returns would at least show a remarkable prevalence of the diseases producing this symptom at the just-mentioned towns, while they would be almost absent from such a fortunate place as Halifax, with a diarrhœal rate of only 0·9.

No, this diarrhœa is more than a symptom, it is a disease in itself, of which an apparently healthy child may die in 1, 2, 3, 4, 5, 6 days, or under a week after seizure.

Out of a total of 216 deaths, 92 infants were ill for one week

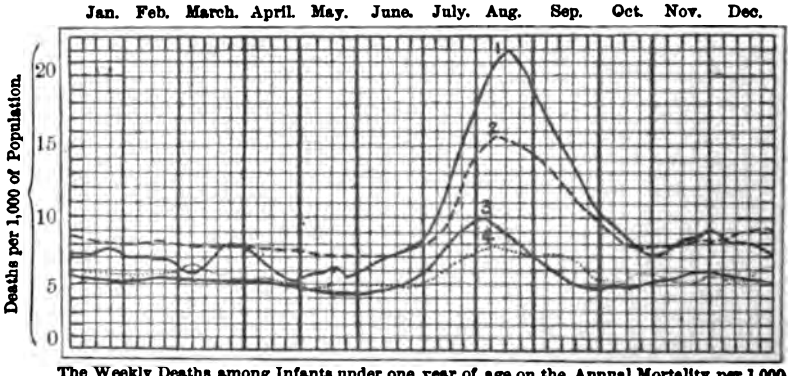
or under, 60 between 1 and 2 weeks, and 44 over 3 weeks. Thirty-three were ill only for 3 days and under, and I have known a previously healthy child to die in 12 hours. My father, when Medical Officer of Health for Leicester in 1851, writes in his report:—"Without denying the influence of weather and seasons, I am of opinion that this disorder is mainly produced by organic decomposition. Its victims will be found to be, exclusively, the very old and the very young—those who from inherent debility are more confined to the vicinity of their own dwellings—thus becoming, as it were, doubly liable to an endemic disorder; the manner of its seizure oftentimes being sudden, like a lightning stroke, and its speedy development (prolonged a few hours certainly beyond the Asiatic cholera) appears to me more nearly to indicate the presence of an organic poison than any other source that could be devised as its probable origin."

This view only confirms the opinion I have formed from my own observation, namely that there is a specific diarrhœa which is present in those towns which have a high diarrhœal rate, and absent from those places where the rate is so low that the few cases registered are probably due to diarrhœa produced by some other disease.

It is very difficult to get *post-mortems* on these cases, still I have made 10, and the pathology, although slight, is quite distinct; I have also found bacilli of the same character in both fœces and intestinal tissue, as I will endeavour to show you.

There is, however, one point on which I believe all observers are agreed, namely, that as the heat increases so the diarrhœal rate rises in those towns where there is a large mortality from this cause.

MR. BUCHAN'S CHART.

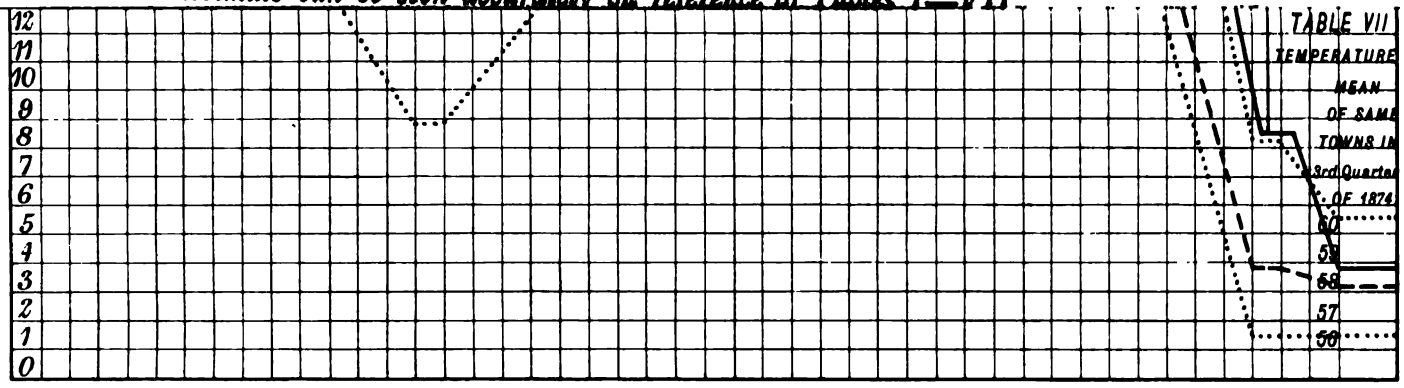


The Weekly Deaths among Infants under one year of age on the Annual Mortality per 1,000 of the whole population. For Leicester, Curve 1; Liverpool, 2; London, 3; and Bristol, 4.

MORTALITY CHART—LEICESTER COMPARED WITH OTHER TOWNS.

The numbers below are derived from the Registrar General's Annual Summary of the Births and Deaths of the Eighteen large Towns of England, for 1874. *The decimals are of course only rendered approximately, thus* 0·8 = 0·2 =

The decimals can be seen accurately on reference to Tables I—VII.



* The Seven principal Zymotic Diseases are Small-Pox, Measles, Scarlet Fever, Diphtheria, Whooping Cough, Diarrhœa, and Fever { Typhus, Typhoid, Simple.

Eighteen large Towns of England:

LONDON.	BIRMINGHAM.	SALFORD.	SHEFFIELD.
PORTSMOUTH.	LEICESTER.	OLDHAM.	HULL.
NORWICH.	NOTTINGHAM.	BRADFORD.	SUNDERLAND.
BRISTOL.	LIVERPOOL.	LEEDS.	NEWCASTLE-ON-TYNE.
WOLVERHAMPTON.	MANCHESTER.		

This is conclusively proved by Mr. Buchan's chart, but he also makes this remark: "At Leicester the summer temperature does not exceed that of Bristol, but while the summer death rate from diarrhœa at Bristol is 2·38, at Leicester it is 9·56; in other words, it may be assumed that there are local peculiarities affecting the population of Leicester, the effect of which is to quadruple the death rate from diarrhœa in that town as compared with Bristol. It is to these local conditions we must look for an explanation of the great differences in the death rate of the different towns."

In London in 1874, the mean summer temperature was two degrees higher and the diarrhœal rate 6 per 100 *lower* than in Leicester. The returns show, as Dr. Buchanan has remarked, that the June heat is not so fatal as the heat of July and August; therefore the effects of heat are not constant. This fact demands further study. Rain-fall also exercises much influence in lowering the diarrhœal rates, especially in those towns where they are remarkably high.

The summer of 1879 was cold and wet, Leicester headed the list with 2·1, while Halifax was at the end with 0·5. The summer of 1880 was hot and dry, and the diarrhœal rates were raised to 13·6 at Preston, 11·5 at Leicester, and 1·4 at Halifax, which still remained the lowest. This is typical of the general results of these influences.

The negative facts concern the many suggestions which have been made as to the etiology of the disease, and though many of these may be considered exploded, they crop up again and again. The favourite source attributed to the complaint is maternal neglect. Out of 216 cases examined by Mr. G. C. Franklin and myself in Leicester in 1875, 24·5 per cent. only of the mothers went out to work. Female labour is much employed in Halifax, Huddersfield and Rochdale, yet the diarrhœal rate in these towns is very low, whereas it is remarkably high at Hull, where there are not so many trades for women to work at.

The bottle also is supposed to be a fruitful source of diarrhœa; yet bottle-feeding prevails in towns all over England whether the diarrhœal rate be high or low; and children fed on mothers' milk are not exempt from the disease.

Another favourite theory is that diarrhœa is caused by filthy sewers; but it existed in Leicester before sewers were made, and does not seem to be materially increased by filth as many of the cases occur in clean houses both in Leicester and in other towns.

In Leicester and in other towns where this disease prevails, there is an ample supply of good water, but the diarrhœal rates have not been influenced thereby.

It has been suggested that infantile diarrhœa is a modified enteric fever. This theory is amply disproved. In all the *post-mortems* I have made, I have not found the slightest resemblance to the pathological conditions of typhoid fever. The period of the year during which infantile diarrhœa is most prevalent does not correspond with the season in which there is most typhoid. I cannot do better than quote the able remarks of Dr. Buchanan on this subject. He says:—

"Arranging, first, the several divisions of England in the order in which 'fever' (the great bulk of which was enteric fever) was fatal in them during 10 years; and putting on the same sheet the mortality of each division from diarrhœa, no visible relation appears between the mortality of the several divisions by the one and the other disease. Again, taking out from statistical returns districts with high or low fever rates, and examining the same districts as to their diarrhœal rates, little or no parallelism in the incidence of the two diseases can be found. Or, making a list of the 25 registration districts of England, that in 1851-60 had most fever, and another list of the 25 that in the same period suffered most from diarrhœa, only one name appears on both lists. The fever districts are seen to be essentially rural or small town districts, the diarrhœa districts to be large towns, most of them manufacturing towns."

Having taken up your time with dealing with theories which, as you have seen, are extremely easy of disproval, I now come to my own idea of this disease. I believe that there are certainly three factors in the production of this specific diarrhœa:—1stly, heat; 2ndly, moisture in the soil; 3rdly, an organism. If you will look at the maps of Leicester on which the deaths from diarrhœa are marked, you will see that these are mainly in the low-lying districts, and not in the higher parts of the town.

Let us also take the towns with the highest diarrhœal rate, namely, Leicester, Preston, and Hull; and compare their situation, drainage, and subsoil with that of Halifax, Bristol, and Huddersfield.

Leicester is virtually in a hole with a canalized river dammed up against it by mills and locks. There is on the north-east of the town a brook, which is held up by the river, and which is known to affect wells to a considerable distance.

Dr. Mason, in his sketch of "The Sanitary History of Hull," says:—"The whole of the soil of the flat around Hull is alluvial clay, or warp of more recent deposits. This deposit

varies from 4ft. to 10ft. in thickness, imposed upon layers of silt, sand, or gravel, the whole of which is incumbent on the chalk formation, which varies from 40ft. to 110ft. from the surface, and rises in high lands and hills to the north and north-west. The area of the borough itself, if we except the variations caused by artificial works, is perfectly flat; from this cause, and the lowness of the ground level, natural drainage would be impossible, were it not for the ebb and flow of the tide in the river Hull and Humber, by which a fall of 10ft. to 15ft. is obtained for several hours daily."

Preston is situated upon a clay soil, which has in it running springs of sand which have an abundant supply of water. The lower part of the town is on a black loamy soil, and underneath is a marshy and peaty sub-soil, and the sub-soil water is from 10 to 15 feet from the surface; that is about the same as Leicester. The river flows at the foot of the slope on which Preston is built, and a canal at a higher elevation than the river runs into the town. There are large cooling ponds attached to the mills; these occupy a considerable area, often as great as the mills themselves.

We will now consider the towns possessing the lowest diarrhœal rate, and for that purpose will take Bristol and Huddersfield.

The medical officer of health of Bristol informs me that the soil of that town is naturally dry, and that the deep and superficial drainage are both good, so that the soil dries quickly after rain. It is built on the new red sandstone, which rises above the alluvial deposit.

Huddersfield is excellently situated on the slope of a hill above the river Calne. Much female labour is employed there. There is a good system of drainage.

Bath and Rochdale both enjoy a comparative immunity from infantile diarrhœa; both towns are well drained and well situated, Bath standing on the slopes and heights of a range composed of Western Oolite, which rises like an amphitheatre from the valley.

I could quote many other towns to support my theory, but I think these illustrations are sufficient, and will now give you a list of towns, drawn up by Dr. Buchanan, giving the results of drainage on sub-soil water and the consequent effects on the diarrhœal rate.

I have left out two towns, as the Diarrhœal Returns were vitiated so as to spoil them for purposes of comparison. One town, Alnwick, certainly does not help me.

Analysis of Dr. Buchanan's Report, 1866.

	Diarrhœal Rates per 10,000.		Changes in Subsoil Water.
	Before Works.	After Works.	
Cardiff.....	17¼	4½	Much drying.
Salisbury ...	6½	2¾	" "
Stratford ...	11¼	5¾	Local lowering of subsoil water. I cannot put this in Dr. Buchanan's words, but the subsoil was evidently much dried.
Merthyr	11½	6¼	The sewers lie deep and have no doubt operated to dry the gravel. Some recent drying.
Banbury.....	11½	5½	Drying of subsoil.
Newport.....	11	6½	Local drying of subsoil.
Alnwick	7	4¾	No drying of subsoil.
Dover	9½	7	Local drying.
Cheltenham..	8½	7	Some drying.
Brynmaur ...	5	4¾	Inconsiderable drying of subsoil.
Macclesfield..	11½	11	Local drying of subsoil.
Ely	4	4¼	Drying of subsoil.
Carlisle	11½	11½	Drying of subsoil, except in large poor area.
Chelmsford...	7	8	No notable change of subsoil water.
Worthing ...	4¾	5½	Much drying of subsoil water. In wet weather the basements and cellars are flooded.
Leicester ...	16	19½	The subsoil water was much reduced in making the works, but it is doubtful if it is so much reduced now, as the subsoil receives the water of a large valley, which yields more water than the drains would be expected to carry off.
Penrith	4	5	No drying of subsoil.
Bristol	6¾	9½	It is known that the wells (generally speaking) are unaffected by the sewage.
Warwick ...	5¾	8	Some drying. The lower parts of the town are gravel, which would probably be water-logged by the dams which hold up the Nicholas Brook and the Avon. (The dams still exist, I believe.—W. E. B.)
Morpeth.....	8½	14½	No change.
Penzance ...	5½	9½	No change in subsoil water.

Professor Virchow, in a pamphlet on this subject, says: "The death rate rises in Berlin in July, August, and September, and this is due to excessive infantile mortality, mainly from diarrhœa." Virchow found the rise of this disease to be coincident with the fall of the ground-water of the Spree. "It cannot be doubted," he says, "that the fall in water levels (*i.e.*, sub-soil water) is conditioned by the increased evaporation produced by the increasing temperature."

Mr. W. H. Power has, under the direction of the Local Government Board, made a careful report on the occasion of his investigation of the outbreak of diarrhœa in Winchester in 1876. After disposing of the questions of which I have treated (*i.e.*, feeding of infants, &c.), he goes on to state that he found a special area in which the disease was most fatal. This special area he describes as including almost the whole of the low-lying inhabited parts of the older city, which is nowhere, except at its eastern and western limits, many feet above, and in places it is below, the river level. The sub-soil is of an alluvial and damp nature. Two rivers traverse this special area, and the natural drainage is impeded by mills and hatches.

The American physicians not only believe in the theory of the fatality of diarrhœa in the low-lying badly drained districts of large towns, but act upon it by sending children under three years of age into healthy country districts for the summer. There is an institution or hospital near New York built for this very purpose.

I have prepared a diagram illustrating observations that have been made of the height of the water in disused wells near the river Soar in this town. The rainfall is given, as well as the fluctuations of the sub-soil water.

These observations have only been made during three years, so it is yet too early to draw conclusions from them; but I would specially ask you to remark the decided decline of the water in the great majority of the wells in July and August, even after a heavy rainfall.

I will, in conclusion, dwell very briefly on the pathology of specific diarrhœa, as this part of the question is perhaps more strictly medical than sanitary. The changes after death are rapid. The ileum is more or less vascular in parts, generally in the middle. The intestine has lost its usual transparency and looks swollen and sodden. The mesenteric glands are enlarged and vascular.

On microscopical examination, after staining by Gram's method, I have found in most of the cases slender bacilli and always micrococci.

I have found similar bacilli in the fœces, together with micrococci and bacterium termo.

Dr. Klein is now experimenting with the cultivation of these bacilli, but the result is not yet published. I just mention this fact, I cannot go into it more deeply; it is a wide subject, and one perhaps more suitable to a pathological society.

Dr. A. Ransome (Manchester) heartily thanked Dr. Buck for his extremely valuable paper, and expressed his regret that many more investigations of a similar kind were not made. Before they could rightly determine the pathology of summer diarrhœa it was essential to have further careful investigation of this kind accompanied by more detailed post mortem examinations. As to Dr. Buck's theory he was only able to speak of Manchester and Salford; certainly experience confirmed what he had said with regard to the influence of a damp and low-lying area. In respect of this particular disease Salford followed very closely after Leicester, and a large part of the town was often below the level of the river, and consequently very subject to floods. No doubt Dr. Buck was right in his estimate of the influence of bad drainage on the disease, but he should like to know what was that gentleman's opinion with regard to the theory put forward some years ago by a former medical officer of Leicester as to the possible origin of summer diarrhœa being emanations from a soil previously saturated with organic filth. The drainage of Leicester was now no doubt very good, but it was only reasonable to suppose that there might have been a previous contamination from the soil pits that formerly existed, and which were highly calculated to foster the growth of organisms such as those to which Dr. Buck had referred.

Dr. Shaw (Leicester) wished to know whether Dr. Buck's inquiries had extended to the lower lying districts of Leicester, such as Home Street, and if so with what result.

Dr. W. Marcet, F.R.S. (London), pointed out that the same conditions which, according to Dr. Buchanan, promoted a low rate of mortality from consumption also promoted a low rate of mortality from diarrhœa. It would seem, therefore, that there was some connection between the two diseases. What was the effect of increased dampness or dryness of the atmosphere upon the human frame? Increased dampness of the atmosphere first of all checked perspiration. Checked perspiration involved a tendency to congestion of the internal organs, relief of which was found in increased secretions or diarrhœa. Checked perspiration also tended to congestion of the lungs, and might thus predispose to consumption. Diarrhœa was promoted by bad smells, heat, and quality of food. The effect of bad smells was very evident from the fact that many medical students were attacked with diarrhœa after spending some time in the dissecting room. It was well known, too, that in hot and damp countries, such as the Island of Madeira, the affection was very prevalent.

Dr. Swete (Worcester) asked Dr. Buck whether he could give any information as to the infantile death-rate amongst the Irish population. At Cardiff, Grayetown, occupied principally by Irishmen, was entirely free from the disease, and at Liverpool there was freedom during the first year of life amongst the Irish population, although after that

age the death-rate was similar to that of the English population. The Irish mother deemed it a religious duty to suckle her children, whilst English children were largely fed by the bottle; here then the milk seemed to be the cause of the mortality. At Worcester infantile diarrhœa was not so prevalent amongst the very poor as amongst the respectable workmen living in £10 houses which were built over old rubbish heaps; here subsoil emanations seemed to him to be the only cause, the infant being placed close to the fire in the cradle, the heat of the fire causing emanation to rise from the subsoil through the tiled flooring. He urged that local authorities should have power to clear building sites of noxious materials.

Surg.-Major PRINGLE (London) said when the condition of many house foundations around London, particularly in low-lying localities, was considered, the wonder was that there was not more sickness, and particularly infantile diarrhœa. The question of subsoil water, too, was of great importance in relation to this disease, from the infants and children being so near the floor level.

Mr. G. J. SYMONS, F.R.S. (London), was very much surprised that Bristol was said to possess a dry subsoil, inasmuch as not long ago he was consulted professionally on the subject of the flooding of certain districts of that city.

Mr. Alderman BARFOOT (Leicester) pointed out, on behalf of the Corporation, that although a system of drainage had been substituted for the cesspits which existed throughout Leicester twenty-five years ago, and although they had now a pure water supply, the diarrhœal rate remained about the same.

Sir CHARLES CAMERON (Dublin) remarked that the City of Dublin, from which he came, was generally described as healthy in consequence of its beautiful situation and environments. He had never held that opinion, for Dublin was built in the valley of a river—and not a very sweet one—the Liffey, into which the sewage of 360,000 people was discharged. The city was so low that the sewers had to be protected from the invasions of the sea by means of tidal gates; it was, in fact, waterlogged. Upon the theory just propounded it should therefore appear that the diarrhœal rate in Dublin was very high; on the contrary, there was very little death there from diarrhœa. Of course there did arise cases of diarrhœa in Dublin, as in other places, but these were very largely the results of eating unripe or over-ripe fruit.

Mr. HANCOCK, F.S.S. (London) asked whether many sanitary difficulties might not be overcome by originally building sewers of adequate dimensions, and whether these difficulties were not due to negligent delay, local authorities so frequently deferring too long

the duty of rebuilding the main sewers found to be inadequate for the purposes that had grown with the growth of the new districts taken over?

Ald. WINDLE (Chairman of the Leicester Sanitary Committee) remarked that the subject of the exceptionally high infantile death-rate had given the Sanitary Committee great anxiety, and for years they had been instituting inquiries and obtaining reports on the subject. Hitherto, however, they did not appear to have solved the difficulty with which the question was beset. They looked forward with interest to the meetings of this Congress and he was specially anxious to hear what the members of the Institute could tell them on the subject. He was bound to say that the discussion, so far as it had gone that morning, had disappointed him. Seeing the immense importance of the question to the people of Leicester he should be very glad if the President of the Institute (Professor de Chaumont) and other gentlemen of eminence present would give them the benefit of their views. Leicester was situated in a valley, they had a clay subsoil, and a most imperfect system of drainage, and their late Officer of Health, who had given an immense amount of attention to this subject, had come to the conclusion that the only exceptional thing in Leicester was the bad sewers, and that sewer gas emanations were the cause of the diarrhœa fatalities.

Dr. GRIMSON suggested the harmful consequences of the warmth of the sun on the subsoil when the water had partially drained off.

Dr. HOLLINGWORTH remarked that in Leicester a very considerable quantity of water drained through the material of the sewer itself. It was only reasonable to infer that much of the sewage drained out into the subsoil in a similar way, to the detriment of the public health.

Dr. ALFRED CARPENTER (Croydon) said there was one point in Dr. Buck's paper which seemed to have escaped attention, although to his mind it appeared to be the very basis upon which the whole subject of prevention must proceed, to have a satisfactory result, viz., the organism to which he referred as the principal factor in the causation of this particular disease. They all knew that organisms required certain conditions for the purposes of their development. In the case of the diarrhœal organism, what were those conditions? They appeared to be a certain temperature, in an impure subsoil with a certain freedom from too much water, diminished supply of oxygen, combined with a certain amount of damp. No doubt the sewers of Leicester had something to do with the impurity of its subsoil. If there prevailed at any given time a warm temperature, as that warmth extended deeper into the earth, the absence of subsoil water would allow the air in the subsoil to get much warmer than if it were waterlogged. The soil was, in fact, in a contrary state to a water-

about our domiciles; the distribution of our institutions for insuring the greatest whether in the school, hospital, asylum, workhouse. All these (and others could be the subjects which we may have to con- have said enough to make you agree with side of the subject. It is quite beyond my permit, to deal in the most cursory manner I therefore propose to touch upon only in doing so, to endeavour to review very condition of certain sanitary works in the stock," so to speak, though necessarily in incomplete manner, of the work that has modern sanitary legislation; to see how far gress, and whether that progress is such as deed as satisfactory.

of recent years would seem to have given a sanitary progress. It is stated in a recent the Local Government Board that the total which were sanctioned by the old General under the Public Health Act, 1848, up to 1st when the Local Government Act, 1858, came 956,178, and the sanctions granted by the under the latter Act, and the Sewage Utili- prior to the date of the constitution of the Board, amounted to £7,363,366. Thus in years prior to the constitution of the Local an aggregate sum of £10,319,544 was the first thirteen years of the Local Govern- of £29,890,353 has been sanctioned in con- administration of the sanitary laws of England the Metropolis. These figures will serve to idea of the extent of the works that have on for sanitary purposes, but of the enor- has taken place in such works during the years. The larger proportion of these expected, is for sewerage works and water these works alone the amount authorised to authorities has averaged during the last five million a year. The total amount of sanctions purposes authorised by the Local Government wards of 2¼ millions a year, which sum sewerage and water supply works, a variety of as street improvements, markets, recreation

report of Local Government Board pages lxxi., et seq.

favourable to the propagation of cognate diseases, such as typhoid fever and cholera. From the discussion which had taken place the Congress must feel that the finger had been put upon the cause of the disease—an impure subsoil. A remedy of the drainage was most essential, and if it were urged that that was impossible on account of configuration of the soil, he would only reply by referring to Salisbury, where a similar difficulty was overcome with eminent success. If the Corporation of Leicester would take this to heart, and would try and establish a low-ground water system, they would soon put a stop to the excessive rate of diarrhœa. What was required was the reduction of the subsoil water fluctuation to its narrowest limits. If this suggestion were adopted, the disease which has so long been an opprobium to Leicester would be practically eradicated.

Dr. W. E. Buck (Leicester) in reply, said he really thought sewers had very little to do with infantile diarrhœa, inasmuch as it prevailed in many towns long before they had any sewers at all; nor had food anything to do with these specific cases. At first sight he thought that there was something in the statement that houses were built on foundations originally filled in with rubbish, but it was not very important after all, inasmuch as the same practice was pursued by most towns. With regard to the City of Dublin, he should like to know whether there was any evidence to show that it was really waterlogged. Of course it would be an advantage if sewers were originally constructed of adequate dimensions, but that was an absolute impossibility, as no one could tell how large a sewer might be eventually required. Many of the Irish in Leicester suckled their own children, but they dwelt in the most unwholesome houses he had ever been in. Their children not only suffered from diarrhœa, but frequently died from it. The streets near the river were not worse off in this respect than other parts.

Dr. Tomkins asked whether the mortality from consumption in Leicester was at all on a par with the rate of death from diarrhœa? According to Dr. Buchanan's theory, it should be very great.

Dr. W. E. Buck (Leicester) said he should think they could hardly find a town in England where consumption was more prevalent among children than in Leicester, but there were a good many reasons for that.

On "Vaccination versus Isolation, as a preventive against outbreaks af Small-pox," by Surgeon-Major R. PRINGLE, M.D., late Sanitary Department H.M.'s Bengal Army.

Of all the diseases which may be considered as most successfully treated and defeated by preventive medicine, I think it will be allowed that small-pox, as met and defeated by vaccination, occupies a unique position. The only claim which I would advance to be heard on this subject is the fact that I have probably seen as much small-pox and vaccination as falls to the lot of most medical officers, in a service of thirty years, of which the last twenty have been entirely devoted to this branch of sanitation in India, the home of small-pox, where the disease is worshipped in the form of a goddess, and where in some parts inoculation has been practised from time immemorial. I trust, therefore, what I may be enabled to advance upon this most important subject, as the result of the practical experience and personal observation of that long period, under such peculiarly favourable circumstances, may prove of practical benefit and assistance to all engaged in the extinction of this most loathsome and fatal scourge, which of all eruptive fevers seems to be the most infectious and contagious. As regards the prevention of an outbreak of small-pox by means of isolation, I have perhaps a peculiar claim to be heard on this point, because in 1863, when small-pox was admitted into the cantonment of Morar-Gwalior, where I was in medical charge of a battery of Royal Horse Artillery, I volunteered, as vaccination was impracticable, owing to the heat of the weather, to limit the outbreak to the few cases first attacked with the disease. This offer was accepted, and I collected them into a tent, which I had pitched to the leeward of the station, and though these admissions extended over a month, cropping up in isolated cases in the centre of cantonments, yet by removing them in the papular or pimple stage of the disease, the infection did not spread, as the cases had contracted the disease from the outside. The outbreak was limited to seven cases, and when the patients had all recovered, I supplied them with new clothes from funds collected by a subscription in the cantonment, in place of the ones I burnt, and let them go to their homes. I

kept the tent standing for some time to see if any more cases of the disease appeared, and when none occurred, I had everything likely to convey or retain contagion burnt with the tent. Months after, the price of this tent was ordered to be deducted from my pay, as I had burnt it without a committee having "sat on it," or rather stood round it. In defence, I explained that I considered the tent not a suitable place for a committee to assemble, adding that I specially selected this tent, as it had been condemned as unserviceable, and if my pay was to be cut, I trusted it might be at the rate for which these condemned tents sold by auction, but respectfully solicited that, in consideration of the *service* rendered by this unserviceable tent, I might be excused paying for it, which request was ultimately graciously granted, and my pay was not mulcted.

My reason, however, for entering into these details is because my action in this instance finally received the entire approval of the military authorities at army head-quarters, and the measures then adopted, and given in my report, are now those directed by general order to be carried out in the case of threatened outbreaks of small-pox, cholera, and similar diseases. The year following, during my absence on leave, small-pox appeared in the Morar-Gwalior cantonment in a similar manner to that just described, but, as no proper measures for isolation were taken, the disease broke out in many parts of cantonments, and not one regiment could be said to have escaped entirely, whereas in the previous year not one case occurred in any regiment, the seven alluded to were camp followers and their families. The misery and suffering caused by this outbreak in cantonments could be seen and gauged, but who will tell that which resulted from the cases of small-pox, which escaped from the cantonments to spread the disease broadcast over the country at a time of the year when, owing to the heat of the weather, vaccination could not be practised?

The town of Leicester, in which the Sanitary Institute of Great Britain holds its annual Congress for 1885, is one in which the subject of isolation, as a preventive measure to ward off an outbreak of small-pox, possesses a peculiar importance and interest, as it must be allowed that by a system of isolation, including the special treatment of the cases of small-pox, the isolation for purposes of observation of suspected as probably infected cases, the disinfection of houses, and all substances likely to hold or convey the infection of small-pox, the town of Leicester enjoys an immunity from epidemic small-pox, which, when its unprotected condition is taken into consideration, is most remarkable, and exhibits a proof of what can be done by a Municipal Sanitary Committee, when it is cordially

supported by the inhabitants of the town in stamping out this most infectious and contagious of the ordinary eruptive fevers. So successful has this system of what I term isolation been, that it is advanced as affording sufficient reasons for rejecting. the present scheme of compulsory vaccination, on the grounds that the same object has been attained, viz., the stamping out of small-pox without having recourse to a system which is charged by its opponents, whose head-quarters may be said to be Leicester, with not only being defective in the attainment of the object aimed at, but with what is the more serious charge of a wholesale poisoning of the constitutions of thousands of helpless children, this being done compulsorily under fines and penalties.

In all that I shall hereafter say, I am particularly anxious that this subject should be treated and discussed with a due consideration for the feelings and prejudices of others, and if the present system of compulsory vaccination requires revision, owing to visible defects in the manner in which it is carried out, by all means let this be done, and these defects fairly faced, and, if possible, removed, that the true benefits of the greatest boon to mankind may be exhibited, not in sheets of statistics, but in what may be called *visible* results and benefits, as exhibited by the complete absence of the small-pox-marked faces, telling of those who have survived the attack, but leaving untold the tales of death and misery which each small-pox-marked case points to in India, and, I doubt not, in this country also; to the former of which I shall allude hereafter. In alluding to the benefits of the first preventive measure, viz., vaccination, as I shall probably describe them, where vaccination has been carefully and systematically performed for a series of years, in terms which might by some be considered extravagant, perhaps unwarrantable, I feel some explanation is necessary for what will be viewed as the remarkable absence of statistics from this paper.

Sanitary statistics, speaking generally, and vaccination returns in particular, require so many conditions to make them of use, and so many more to make them absolutely reliable, that before they can be accepted as data, they must be carefully examined and tested by other statistics, whose value has been *visibly* proved. Twenty years of vaccination statistics in India, if I may judge by the North-West provinces of India, of which I have a personal knowledge during that period, have satisfied me that, as a rule, those vaccine statistics are not only worse than useless, but are absolutely misleading. So readily however have they been accepted as true, that in some cases departmental promotion up to the highest grades has been

given, for what the Government of India, when the imposture was laid bare, stigmatised as "a wholesale fabrication of returns." Judging therefore from what I have seen and known, if I were asked what opinion I have been able to form, if any, regarding the benefits of vaccination, as they appear in the published reports of the Government of India, I should unhesitatingly say they were to a serious extent quite unreliable, and, owing to the extensive outbreaks of small-pox in some districts, such as gravely to shake the faith of every true believer in vaccination. When, for instance, you know of districts with populations of upwards of two-thirds of a million, and the birth-rate vaccinated, *on paper*, for years, and yet small-pox epidemics constantly occurring in them, what other conclusion can possibly be arrived at? To shelter these unsatisfactory results behind the shield of worn-out protection, or the neglect of re-vaccination, is, in my opinion, unworthy of the science of medicine, which in this case would have to alter its laws to suit the bad work of careless or ignorant vaccinators, or the false work of unprincipled ones. Where really good vaccination has been carried on for any number of years, the protection imparted is in exact proportion to the ratio between the birth-rate, and the number successfully vaccinated: if the birth-rate is sufficiently reached by successful vaccination, and small-pox occurs in any but isolated unvaccinated cases, then the work is bad, or the returns false, or both. I am perfectly satisfied on this point, having proved it incontestably, and this exemption from small-pox, with a sufficiently approximated birth-rate is, I have found, attainable, without the performance of a single case of re-vaccination, during twenty years of my own practical experience and personal observation in one sanitary circle, with a population of ten millions, and a birth-rate of half a million.

I feel compelled to preface what I have to say with these remarks, as it is melancholy to think of the condition into which vaccination has lapsed in the North-West Provinces and Oudh, owing to *quantity* not *quality* being the stepping-stone to promotion. I did my best for years to stem this tide of false vaccine returns, by declining at considerable risk to my promotion, to have anything to do with re-vaccination, but without avail, and when I disclosed the whole system in 1880, this exposure was systematically suppressed. I distinctly informed the Government of India that if, after this exposure, they allowed the officer mainly responsible for its suppression from 1880 to 1883 to retain his appointment, I would resign, and, as they retained this officer, I resigned the service rather than have my name longer associated in any way with what the Government of India described in an official document as a "wholesale

fabrication of returns." Before resigning, however, I drew from the Government a statement, that my circle of vaccination was exempt from these charges, and that no question had been raised even regarding the correctness of my vaccine returns. In self-defence I record these facts; this exposure is public property, and it is possible that, without this vindication, my uninterrupted labour for twenty years in one circle may be classified with what the Government has stigmatised as above, and the conclusions I have formed on the results of my work be looked upon as valueless as these vaccine statistics.

Perhaps I can best discuss the relative merits of vaccination and isolation by asking and answering two questions:—

1st. What is small-pox in India?

Answer. A universal disease, leaving where inoculation or vaccination are not practised its *visible* results on 95 per cent. of the adult population.

2nd. What is cow-pox (vaccination) in India?

Ans. That which can be made a similar universal disease, imparting, where it is carefully and systematically practised, an immunity from small-pox, such as even its great discoverer could never have expected, because he could not have supposed the prophylactic could have been subjected to such severe tests as it has to meet annually in India.

The answer regarding the universality of small-pox in India may appear to many in this country startling, if not incredible, but vaccination, notwithstanding all it is charged with, has resulted in an absence of small-pox which, I fear, has occasioned ignorance, which has produced indifference as to what small-pox is, when unchecked by inoculation or vaccination, and I shall now try to throw some light upon this ignorance, if only in all kindness to warn Leicester of what may be near it with its hundreds of unprotected children. I shall not, however, exhibit this by means of statistics, showing the deaths from small-pox where the disease is unchecked, though if there are any sanitary statistics in India which may be accepted, they are those of small-pox mortality, for the following reasons. There may be doubts as to what is true and spurious cholera, what is simple fever, fever of starvation, jail fever, or fever with typhoid symptoms; but a death from small-pox is a death from small-pox and no other disease, because chicken-pox as a rule is unknown in India, except as an adult disease, and therefore rarely fatal, whilst small-pox is a disease of infancy, or under puberty. Further, there was no reason to conceal deaths from small-pox as there was deaths from cholera. The inquiries *then* and *now* made about cholera and tabular statements called for, often tax an overworked European official very considerably,

and if he shows this, the natives are not slow to see it, and act accordingly, thus accounting for the remarkable freedom of some localities from the fatal scourge, when it is prevalent in the neighbouring districts. Now, however, that vaccination is made compulsory, under certain conditions, this system, unless carefully carried out, will lead to the concealment of the disease, for fear of the infliction of compulsory vaccination, with its fines and penalties.

The twenty years, however, over which my observations extended were years in which, in some instances, the poor ignorant villagers, who, worshipping the scourge as a goddess, pointed to the few children left to vaccinate with an expression of religious resignation; the goddess of small-pox, "Seetla" by name, had taken their children, and it was with difficulty I could persuade them in some instances, to accept vaccination to preserve a remnant in their village. When therefore we read of 170,000 deaths from small-pox in a population of forty millions in one year, we may be sure this number at least died of small-pox and no other disease, or when in 1863 in the city of Muttra, with a population of 44,000, small-pox in two months carried off 3,500 children, a fact vouched for to myself by the medical officer of the district, some estimate may be formed of the mortality from small-pox in an unprotected population. In Muttra in 1883, a year of equal small-pox prevalence as 1863, not one fatal case was recorded from this disease—but here I had been vaccinating for twenty years with the cordial support of the people of the town.

The only figures I shall give resembling statistics are those to show the universality of small-pox in the North-West Provinces of India, and they are more *visible* results than compiled statistics.

The inquiry was carried on between the years 1861 and 1872 in certain jails in the North-West Provinces of India, where the records on the subject of small-pox had been carefully kept.

Total number of prisoners examined 268,445.

			Per cent.
Number exhibiting visible marks of small-pox	228,964	or	85·29
Number with doubtful marks	20,480	„	7·63
Unprotected	12,215	„	4·55
Inoculated	4,233	„	1·58
Vaccinated	2,553	„	0·95
	268,445		100·00

Now, in a country where chicken-pox is a rare disease, the doubtful cases may be classed with the small-pox-marked cases,

bringing up the total to 90 per cent., while the unprotected—*i.e.*, unmarked—cases would, had the examination been carefully made, no doubt have showed a few small-pox marks, which would bring the percentage to nearly 95, and, I may add, the condition of the jail population as regards small-pox may be taken as nearly similar to that outside of the jail. This universality of small-pox is no doubt due to the regular annual appearance of small-pox, and I do not think two per cent. could be found to be proof against this annual visitation, more especially as no isolation is thought of, and at the small-pox festivals children covered with the disease in every stage of the eruption mix freely with those as yet free from it.

Now, if we examine the schools, we find between 50 and 60 per cent. are visibly marked with the disease, this smaller percentage is due to the fact that the children of the better classes enjoy, by means of their isolation while young, a certain immunity, which, however, unless they are vaccinated or inoculated, they soon lose as adults, when they have to go into the world and encounter the infection and contagion to be met with in the villages, streets, and markets. What would be thought in this country of parents withholding from their child its chance of succession to property till it had suffered from small-pox, and recovered, as, not till then is its life calculated upon, so as to require provision being made for it. When I began the system of voluntary vaccination in my circle in 1864, at first only the children of the lowest castes were obtainable for the operation, and in villages where female infanticide was practised, and which were thus under the Act to prevent that practice, the *girls* were submitted for vaccination in the hopes, I presume, that they might die from its effects. The very opposite, however, was proved to be the result, and while the boys in these families were swept off in numbers by small-pox, the vaccinated girls lived! These tactics had, therefore, to be changed, and the girls are now kept from vaccination in hopes that they might die from small-pox, when no questions are asked! I have seen a gap in the population due to an outbreak of small-pox, *i.e.*, only a few children between the years of 8 and 12, though there were numbers under 8 years. With the present beneficial effects of vaccination such a force of infection and contagion is impossible, but there is no reason whatever why Leicester some day may not be visited like Muttra. When the cases are few the contagion can be stamped out, but it is quite a different thing when the numbers increase, and the first failure of these measures of isolation to limit, and then stamp out the disease may prove terribly disastrous, and after this picture of small-pox, where protection is unknown, or very limited,

Leicester cannot say she has not been warned. It must be borne in mind, when alluding to the success of isolation in Leicester, that it is mainly due to the success of vaccination *outside* the town, which only admits of the few isolated cases attacking the fortifications of isolation almost singly. These attacks are easily, comparatively speaking, successfully resisted, but if the opposition to vaccination increases around Leicester, and the number of unprotected become greatly increased, the attacks will have to be met at numerous points, and I question if they will then be successfully defeated. When, if once the enemy gets into an unprotected town like Leicester, it will, I feel, fully repeat the tales of death and misery I have seen in India. Again, what is to prevent the unprotected cases leaving Leicester like the boys in the schools in India and afterwards suffering from small-pox, except the acceptance of vaccination in the places in which they live? In short, to take the entire credit of stamping out small-pox by means of isolation is not fair to vaccination, which with all the false charges which have been brought against her, has yet returned good for evil to an extent which only those can calculate who have seen small-pox raging where vaccination is either unknown or but rarely practised.

I will close this portion of my paper by showing what careful and systematic vaccination can do in the home of small-pox. What would be thought in this country, of children covered with small-pox, at the most infectious period of the disease, running about at the washerman's village, among the bundles of clothes belonging to a large military convalescent depôt in the Himalayas, and a still larger civil hill sanatorium, without the faintest attempt at any precautionary measures? But this actually happened in the case of Landour and Mussooree in the Himalayas in 1883, and yet there was no rushing about to get re-vaccinated. Nothing of the sort, a feeling of protection existed, fully justified by not a single case of the disease appearing in either of these stations, in which I had been vaccinating for twenty years without re-vaccinating a single native whom my subordinates or myself had vaccinated during that period. In mentioning this instance, and others, to some professional friends in this country, they admitted that these favourable results were not likely to be met with in this country, in thickly populated localities, and I can quite understand this from the large number of operations performed with "stored lymph." All my work in India was with fresh vaccine lymph, taken by the operator from a vesicle the outcome of his own work; this is what I call careful and systematic vaccination, which will without fail exhibit the triumphs of vaccination. There are

numbers of medical officers in this country whose vaccination is carried on in a similar manner, in whose practice small-pox is unknown, except in the case of a poor tramp passing through the town or village. Let Leicester awake to a sense of its real danger; and perhaps the following may show how its present critical situation may be exchanged for one of conscious security. During the cold season, when vaccination can alone be practised in the plains of India, a few cases of small-pox were admitted from the district into the City of Meerut with its population of 80,000; an enquiry exhibited an alarming number of unprotected children. A meeting was called, at which I promised to remove all this danger of small-pox if all assisted. This they not only promised, but carried out most faithfully, and in five days 2,200 children were vaccinated with a success of 98 per cent. and the supply of children failed before that of the vaccine lymph. This happened about ten years ago, and ever since Meerut has been exempt from small-pox; the visible benefits of these extensive vaccine operations were apparent to all, and my vaccinators experienced no more difficulty in their work. Subsequently this work was repeated in Alighur, Hattrass, and Khoorjah; other instances could be given, but these will, I think, suffice.

I now come to the subject of the preventive measures summed up in the term isolation; and in this city I would draw particular attention to them, as adopted by the sanitary committee to stamp out small-pox, without having recourse to vaccination, and they are certainly most instructive, and should cholera visit our shores will be invaluable, as proofs of what can be done in the instance of the most infectious and contagious of known eruptive fevers, viz., small-pox, when all combine to attain one object; in this case to exhibit the non-necessity of vaccination, as a means of stamping out small-pox. These measures consisted in isolating and treating the cases of small-pox in special hospitals, but as I can quote Mr. Windley's exact words, I think I had better do this. In a letter to a provincial paper dated February 17th, 1885, Mr. Alderman Windley, chairman of the sanitary committee, writes as follows: "In addition to the above," (*i.e.*, the prompt removal to hospital,) "I may say we not only remove any case of small-pox to hospital at once, but we also persuade all the persons who have been found in the house at the time to take up their abode in a separate ward at the hospital for fourteen days quarantine; in the meantime thoroughly disinfecting bedding, clothes, and house from which the patient was removed."

I am satisfied that short of vaccination nothing more could be done to stamp out the disease if admitted, and that this has

been successful, thanks to vaccination outside, need not be a matter of surprise. But what does all this success depend upon? The cordial concurrence and support of the entire community, and the earnest desire of every member of it to act faithfully up to the wishes of the sanitary committee, and to aid them by every means in their power. Now, suppose into this hitherto unanimous community comes a family, the head of which objects on principle to any preventive measures whatever, even goes the length of objecting to treatment for small-pox, and considers isolation, separation for observation, and disinfection, as an interference with the liberty of the subject. Where would this confessedly successful method of stamping out small-pox be, if in this family a single case of small-pox occurred? Have the sanitary committee power to enforce these rules of sanitation, and to isolate this case against the parents' will, and to place the rest of the family "in a separate ward at the hospital for fourteen days' quarantine," or, is it, as Mr. Windley's letter would lead one to suppose, a case of *persuasion*, not *compulsion?* If the sanitary committee have not this power nothing will prevent the disease spreading in a case like the one I suppose, and, like a fire, the greater the number of susceptible cases it finds, the more fiercely and irresistibly will it burn, till it has burnt itself out, or is checked by the barrier of insusceptibility to the disease, which careful and systematic vaccination can alone supply. Further, it must be remembered that though isolation, separation or observation, and disinfection may stamp out the disease if its admission is confined to a few isolated cases, all three will in this country prove utterly powerless if the cases increase in number, or become at all scattered. The triumphs of vaccination at Meerut, and alluded to before, are all placed on public record, and guaranteed by independent and disinterested witnesses, and there is yet time for Leicester to be the scene of one of these triumphs. The slightest carelessness in these measures of isolation might bring Leicester at any time face to face with a calamity worse than many towns in Spain are now suffering from. I have seen cholera and small-pox both claiming their victims by hundreds, and to my mind there is no comparison between these two awful scourges; the unrecognizable victims of the most loathsome of known diseases cannot, I repeat, be compared with those of cholera, where the strong and healthy are struck down as if in battle by an invisible blow or wound, and if they recover they resume their journey with constitutions only temporarily weakened, as I know from my own experience, and not in the least permanently affected; with small-pox it is totally different. Go into a Mahomedhan village near Boolandshur, for instance, and see the sightless

men, and all from small-pox, mostly blind from their boyhood or even childhood, depending for their food on those in many cases living on the margin of scarcity if not want. But why do I say Mahomedhan villages? Because the ties of caste among the Hindoos limit the friends of the blind victim of small-pox; and when scarcity of food is added to all, an unparapetted well or a hugh cart-wheel in a narrow lane in the village too often end the sightless existence of the poor Hindoo lad. I believe very few cases of severe attacks of small-pox ever make good recoveries, and in India, among the poor, the burden of life is not unthankfully parted with in the case of a weakened or crippled child. That which made me in 1864 decide on devoting my whole energies to the relief of humanity suffering from small-pox, was the case of a wealthy banker; he had lost eight children from small-pox, and he brought the last child, a boy, to me, as he had heard that there was an English medicine for small-pox, and would I give it to his last and only child? This must be my excuse for pleading thus earnestly for the children in Leicester.

In closing, I would like if possible to answer some of the objections usually brought against vaccination. These I think can be summed up under two heads, viz., first, the fear of the child's system being poisoned with impure vaccine lymph, and secondly, the discomforts attending the operation among the children of the working classes, whose time is so fully taken up, and who can but ill afford to pay for extra medical attendance on their children, if such is necessary, as the result of submitting them to that which is compulsory under fines and penalties. As regards the first, I am sure if fresh vaccine lymph were invariably employed, and the operator saw the vesicle it came from, we should hear less about these local inflammations and eruptions, and the whole course of the vaccinal eruption would be such as to remove that dread of the operation, which seems to be so general. I am aware that I shall be told that there are cases in which it is simply impossible to operate always with fresh lymph; it is possible there may be such cases, then let the operator know how to store his own vaccine lymph in tubes, as I have had to do and to teach for months every year in the Himalayas, owing to the hot weather in India being fatal to the course of characteristic vaccinia. What can be overcome in India can surely be overcome here in a cool climate, where the vesicle can be carried on all the year round. What I fancy is wanted is practical teaching, not theoretical, the supposed simplicity of the vaccine operation, and the little supposed-to-be-necessary knowledge about vaccination, are the greatest obstacles to the successful carrying out of the scheme; and I am satisfied

that if more knowledge were acquired on the subject, and more care devoted to the primary operation, we should hear less about the necessity of re-vaccination, from loss of protective power by deterioration in the lymph, or lapse of time since the primary operation; and this joint in the vaccine armour, through which alone it is assailable would be for ever closed up. We hear now-a-days of the frequency of alarming symptoms following re-vaccination, and I am not the least surprised at it; much of the calf lymph now in use is largely made up of serum, the result of local inflammatory action, squeezed out by the clamps or forceps on the vaccinal eruption, after all the lymph has exuded, and to insert this serous fluid into the system of a full-blooded, perhaps well-fed, and stimulated adult, without preparation, or caution as regards diet or exercise of any kind, appears to me a very serious undertaking, and I have seen it produce alarming results in some particular cases. After a considerable study of the subject, I am decidedly of opinion that inoculation scientifically carried on, by cultivated lymph from selected eruptions, without any thought of repetition of the operation, is infinitely preferable to vaccination with re-vaccination every seven years, or whenever there is a small-pox scare. For twenty years I have devoted my entire energies to supplanting inoculation by vaccination, which I should never have done had I believed in the necessity of re-vaccination. As I have never practised re-vaccination, and yet expelled small-pox from towns, cities, and districts, wherever I have sufficiently approximated the birth rate with successful vaccination, I am not likely to practice inoculation, or recommend it, having secured all I want by careful and systematic vaccination. When trying to supplant inoculation by vaccination, I found an objection raised to my vaccinator not being at hand if required to see a case; whereas, the inoculator lived in the village where he was operating till all the cases had recovered. I pointed out to these people that after inoculation small-pox appeared in many cases, and some of them were often very serious ones; with vaccination this never happened, and the worst that could occur was the part operated on, owing to heat, flies, dirt, &c., sometimes taking a considerable time to heal, but I said the vaccinator would operate in the neighbouring villages in such a way that he could be readily found, and would attend and treat the case if necessary. This quite satisfied them, and except where the vaccinator was clearly to blame I never had any trouble under this head. I would therefore ask only those best qualified to speak on this point, if these objections are similarly met in the practice of compulsory vaccination in this country. The upper classes can have their children vaccinated by their own

doctor, and, if necessary, attended by him; simple justice therefore demands that that which is compulsorily enacted, and may require on that account medical attendance, in the case of the poor should have the same means of alleviation *gratuitously* and *ungrudgingly* supplied by the State, which the rich can secure by payment. I am aware that the great obstacle to all this lies on the score of expense; but take the case of London, who will calculate the expense and misery attendant on the small-pox hospitals of the metropolis, and the removal of patients to them? Exceptional circumstances must be met by exceptional measures, and I feel that the worst way to treat small-pox epidemics is by the erection of large small-pox hospitals. Let there be a staff of public vaccinators, specially trained to work with fresh lymph, for which they alone will be answerable, exempted from all other medical duties, and then there will be less chance of erysipelas appearing among the lately vaccinated cases, the people will see an increased attention given to their comfort, in the compulsory carrying out of that which is designed to protect the public from small-pox, and the valuable assistance of the parents will be secured, which all who have practised vaccination extensively know the importance of, when collecting lymph for future operations.

As regards the possibility of imparting other diseases with the vaccine lymph employed, I am, of course, aware of the experiments on the subject, and the opinions generally expressed, but, judging from my own experience, which I suppose is as extensive as that of most, I have not met with a single case in which vaccination could be charged with the introduction of any injurious germ whatever. The *very few* cases in which alarming and distressing eruptions have followed the operation in young children, have been due to the lighting up of that which had been *inherited*, not *inserted*. I desire to speak most positively on this point, as I have satisfactorily proved it in every case which has occurred in my practice, or that of my vaccinators, and which have been reported and seen by me. I have met with two cases; one, that of a pure European, and the other a Eurasian, in which I declined to vaccinate the children, unless vaccination was held blameless for what might follow the operation, as it would clearly be shown to be due to hereditary causes. With this I will close, and can only trust that what I have said, and which is the outcome of practical experience and personal observation, not statistical data and theoretical conclusions, may prove to be of practical benefit and assistance.

Alderman WINDLEY (Chairman of the Leicester Sanitary Committee) said the reader of the paper had come to curse the system of isolation, but started by blessing it, showing that he had stamped out at least one outbreak of small-pox in India by its means. He agreed with the lecturer as to the comparative worthlessness of vaccination statistics, but doubted his assertion that the success of isolation here was due to the success of vaccination outside the town. As to the warnings which the lecturer had given, they had heard them many times before; and while they did not alarm him, they might act as a stimulant to increased vigilance on the part of the sanitary authorities. Dr. Pringle, having been connected with the army, would know what would happen to a sentinel if he should be found asleep at his post; and so he should say public opinion would condemn the sanitary authority here if they allowed any laxity to take place in their mode of dealing with small-pox. He had not a word to say in disparagement of the interesting statement made by the lecturer as to the success which had attended his vaccination in India, that statement would no doubt have due weight with the public; but he was in error in supposing that the system of isolation adopted in Leicester was instituted in order to stamp out small-pox without having recourse to vaccination. It was adopted at the suggestion of the late officer of health, who was a firm believer in vaccination, and it was simply to prevent the spread of the disease when it was imported into the town. Leicester was one of the first towns to adopt the Notification of Diseases Act, which had worked satisfactorily. As soon as a case of small-pox was notified, they took immediate steps to remove the case to hospital, to disinfect premises and clothing, and to persuade the occupants of the house where the case was found to go into quarantine for a fortnight. The necessity for this had been proved, as persons so removed were sometimes found in two or three days to be affected with the disease. They had no compulsory power beyond that given by the Public Health Act, which applied all over the kingdom; but if householders refused to go into quarantine they would send an officer every day to inquire at the house, so that the danger of infection should be reduced, and of course it would be their duty to warn persons of the penalties they were liable to if they exposed others to contagion. He would like the experience of Leicester to be made widely known by means of that Congress. In 1852 there were 52 deaths from small-pox, in 1858 there were 53, in 1864 there were 104, and in 1872 there were 346; that was before they had the Notification Act, or any means of efficient isolation; since that time, and under their present method, they had not had a single epidemic of small-pox, and a large number of imported cases had been dealt with, and the disease in each instance stamped out. Therefore he thought that instead of the constant repetition of these terrible warnings as to what might happen, the sanitary authority were at least deserving of something more gracious, not to say complimentary. He, Alderman Windley, was glad to leave medical men to praise or condemn vaccination statistics, and to settle their disputes as to the value of vaccination and revaccination,

and for or against vaccination from the calf; what he found was that the outcome of the system of vaccination was repeated failure. In proof of this he quoted the following sentence from a recent report of Dr. Seaton, officer of health for Chelsea:—"The ratepayers of London have spent millions of money, and small-pox, the disease which should have been limited, if not prevented, has, during the last few years, been worse than ever in its ravages." With that state of things he, Alderman Windley, would contrast the experience of Leicester, and he claimed that what Leicester had done other large towns might do. At London it was not possible, while they had thirty-nine different authorities, who did not act together in this matter.

Prof. W. H. Corfield (London) having complimented the sanitary authority of Leicester upon insisting on the isolation of small-pox cases, said it was possible that a general belief in the efficacy of vaccination had led sanitary authorities to be to a certain extent negligent in the matter of small-pox cases. When it was said that isolation was preferable to vaccination, he must reply that the two things were not to be compared in that way. Isolation and vaccination must go hand in hand, and the time must come when isolation alone without vaccination would be totally unable to deal with small-pox. When that time came there would be a terrible awakening for Leicester. He presumed that vaccination statistics were as good as any other statistics. Statistics were the application of figures to the facts they had before them. Every science was perfect as it was amenable to mathematical processes. Every science was more perfect as it became amenable to the application of figures. Statistics were at present nearly the only form of mathematical test that could be applied to the facts of public health. Of course they might be falsely interpreted by those who did not understand them, but he thought no one could look at the remarkable figures published in the German Vaccination Report without seeing that they told a very plain tale. Up to the year 1873, small-pox was rife in the German and Austrian armies. In March, 1874, the Reichstag passed a law making vaccination and re-vaccination compulsory throughout the whole of the German Empire. The result was that since then there had been hardly any small-pox in Berlin, and while in the German army there had been a slight amount of sickness, there had not been a single death from small-pox in the whole of that vast army up to the present time. Surely anti-vaccinationists did not know what small-pox was in the last century, when it was a disease which caused one in twelve of the deaths from all causes. In 1796, when it was most fatal, it caused no less than 184 deaths out of every 1,000 deaths from all causes in this country. It slew one-fifth, and in its confluent form one-half, of those whom it attacked; it caused from one-half to two-thirds of all the cases of blindness in Europe, and disfigured those it neither killed nor rendered sightless. Thus the whole people in the last century was practically a pox-marked race. Anti-vaccinationists seemed to forget that this disease became so prevalent, and was so universally distributed, that the most

extraordinary method was taken to meet it. That method was the inoculation of healthy persons with some of the poison of this terrible disease—one of the foulest diseases that has ever appeared on the face of the earth. This plan was discovered in China, and was imported into this country from Constantinople by Lady Mary Wortley Montagu, and it was employed throughout all ranks of the population, and extended even to the royal families. The royal family of Sweden and that of our own Sovereign, George III., were inoculated with small-pox. That system of inoculation had but one meaning. The fact was it was not worth anyone's while to wait until he caught the small-pox. The disease was so widely distributed among the whole population that it was better to be inoculated with the poison, to have the disease in the milder form given by inoculation, and to be protected for the rest of one's life. As to revaccination, it was demonstrated by Jenner himself, the discoverer of vaccination, that both vaccination and revaccination were necessary. For fifteen years after Jenner practised vaccination there was no case of a vaccinated person contracting small-pox. After that time some cases did arise. The statistics that had been gathered from various armies throughout Europe, had proved beyond all contest that revaccination in riper years was necessary as a complete preventive of small-pox. That vaccination was an almost absolute preventive was shown by the fact that during the 1870-1 epidemic, out of nearly 15,000 cases treated in the London Hospitals, there were only four which showed proof of revaccination, and these were mild cases.

Mr. F. T. Mott (Leicester) said he was in favour of vaccination, but one of the arguments of the anti-vaccinators, viz., that small-pox was dying out, as all other plagues had done in their turn, had not been definitely answered, and it would be useful if the lecturer would answer it.

Sir Charles Cameron (Dublin) addressed the Congress, and in the course of a humorous speech said that there was no population more thoroughly vaccinated than the Irish people, and a population free from end to end of small-pox. He thought that perhaps a little too much had been claimed for vaccination. All that they could claim for it was that it lessened the susceptibility to contract disease when it was epidemic, and enormously lessened one's chance of getting the disease. He had found from investigation that in the case of persons vaccinated the disease ran, as a rule, a much milder course.

Dr. Alfred Carpenter (Croydon) commended the measures taken by the Leicester Sanitary Committee for the repression of small-pox. They were measures which ought to commend themselves to the attention of all other sanitary authorities in the kingdom. The steps taken by the Leicester Sanitary Committee corresponded somewhat with the measures that were taken by a local authority in endeavouring to repress fires. It was requisite to maintain a certain fire brigade

arrangement, so that when a fire attacked inflammable material it might be put out before it reached any very large dimensions. That was an absolutely proper course to be taken, but there was another course that could be followed, and that was to make the material non-inflammable. Thus by vaccination it was proposed to make the human body non-inflammable to small-pox, in order that there might be no propagation of disease. It was urged that statistics should be put on one side as not always trustworthy, but he would give some particulars that were absolutely unimpeachable. Last year he, Dr. Carpenter, with about 25 medical men, went down to the camp at Darenth, where there were more than a thousand cases of small-pox under treatment. They went among the cases, examined them, saw their character. The whole of them were there for some hours, and became thoroughly permeated with small-pox germs, and yet not one out of the whole number was affected by the disease. Send twenty-five men who had not been made non-inflammable down to the small-pox hospital at Darenth in the same way, and he would guarantee to say that at least four of them would go into their coffins in consequence of their visit. It was quite true that vaccination was not entirely protective, nor was small-pox itself. Cases of small-pox among people who had been properly vaccinated were exceedingly rare, whereas he had known of people who were small-pox marked having the disease a second time to a very considerable extent. The inhabitants of Leicester and other towns in this country appeared to know nothing of the ravages of small-pox in unprotected districts. He should like those gentlemen who were earnest anti-vaccinators to be compelled to take the nursing of two or three cases of confluent small-pox in persons not vaccinated, and then compare such cases with the confluent form, which was, however, exceedingly rare, in those who had been protected by vaccination. If after that they did not become true earnest desirers of vaccination he should be extremely surprised, for he could assure those who knew nothing about small-pox there was nothing so horrible, nothing so terrible as that disease occurring in a confluent form in the unvaccinated. The vaccinated, on the other hand, when attacked, got through it in the most comfortable and satisfactory manner, and suffered none of the horrible torture and results which were the fate of the unvaccinated.

Mr. J. T. Stephen congratulated the Sanitary Committee on the *modus operandi* they had adopted for treating small-pox. He pointed out that cases of infection which had appeared in Leicester had invariably been introduced from other towns, and contrasted the state of the borough with the condition of other boroughs where vaccination met with little resistance. He thought the Sanitary Committee were going the right way to work, and he trusted that they would continue to practice the methods that had been adopted, while he endorsed the suggestion of Alderman Windley, that anti-vaccinators should be treated a little more leniently by the magistrates.

Professor de Chaumont, M.D., F.R.S. (Southampton) remarked

that the system of inoculation of the last century was certainly not a benefit to the community if it were to the individual, as the individual inoculated was often the centre of infection, and made the Government press forward the system of vaccination. The sudden and remarkable way in which the disease ceased and continued absent for many years was a distinct proof of the efficacy of vaccination, although experience had shown that the vaccine influence was not entirely protective throughout the whole course of life. He thought they might well congratulate the Sanitary Committee of the Corporation of Leicester on what they had done for the isolation of disease. Their action had been admirable, but they were only carrying out what had been insisted upon by the medical profession for a long while. They had dealt successfully with a fatal and contagious disease, and he hoped their example would be followed throughout the country. They could not, however, say that that was a reason for giving up vaccination. The success attending what had been done in the borough should encourage all others, as far as possible, to carry out measures of isolation and other sanitary preventive measures which would tend to the diminution of the disease. He could not, however, go so far as Alderman Windley, that that was a reason for mitigating the penalties. The law ought to be carried out thoroughly, and he saw no reason why the cumulative penalties should be dispensed with. The only alternative he thought would be that the law should give power to the magistrates to order the child to be taken and vaccinated, but unless the vaccination laws were properly enforced they had better be abrogated altogether, and vaccination left to the common sense of the people.

Dr. A. Ransome (Manchester) referring to the remark of a previous speaker as to the disease existing in one place and being non-existent in another, said that many of them could remember that when the disease of small-pox was prevalent in the Austrian army there was not a single case in an adjoining country. Mere isolation without removing the cause of disease was a very doubtful expedient; and he must point out to Leicester that when contagion crept into unprotected districts not previously visited for some time, it generally carried off enormous numbers.

Surgeon-Major Pringle (London) said, in reply, that he had practised isolation in India because the only expedient he had in the hot season was to isolate small-pox patients; but when he could vaccinate he vaccinated 2,200 children in five days, as he did in Meerut in the cold season.

On "Impediments to Sanitary Progress," by LEWIS ANGELL, M.Inst.C.E., Fellow of King's College, London.

ALTHOUGH sanitation claims to be recognised as a science, it can hardly yet be included among the exact sciences. When we speak of sanitary progress, the results are not infrequently challenged. That sanitary progress means the elimination of extraneous preventible causes of disease, is an abstract proposition to which all will assent, but in the practical application of the proposition we find many shades of difference. For example, the most urgent sanitary question of the day is that of sewage. Sewage in solution in our rivers; sewage gas in our streets and houses. Within the present month the author has had to inspect the condition of a remote borough wherein sanitary principles are almost absolutely unknown; in the course of the inspection an informal meeting of the town council was called, in order to convey to the author the respective views of the members upon what they understood by sanitary principles. One worthy alderman asserted that underground drainage was ruination to a town, causing great injury to health, low fevers, &c.; that street ventilators were worse than cesspools, and that it is better to live in an undrained than a drained town. Another of the council declared that the universal adoption of earth closets was the only proper method of dealing with the matter. One was in favour of sending the sewage direct to the sea. Another was for turning it over the land; while yet another pronounced for the retention of the old-fashioned unadulterated cesspool. Such were the author's instructions. Can we be surprised at the differences of opinion among the inexperienced in sanitary matters in the face of the experiments and the failures, the royal commissions, the local government inquiries, and the Parliamentary committees of the past twenty-five years? Just now, during the "silly season," the pollution of the Metropolitan rivers by the Metroplitan and local boards has afforded an opportune subject for the daily papers, and not a moment too soon. We all join in the general confession that we have left undone those things which we ought to have done, and done those things which we ought not to have done, and there is no health in us; but we show no signs of repentance. We separate into sects and parties, each shouting its own sanitary shibboleth.

The object, however, of this paper is not to discuss the sewage question, but to illustrate some of the difficulties of putting into

effective practice those abstract principles of sanitation upon which we are agreed.

Public health legislation was practically commenced in 1848, and added to year by year till the principal Act and various amending Acts were consolidated in 1875. Ten years of experience and advanced knowledge have shown the conspicuous defects of the 1875 Act, as well as the weakness of that mythical and ever changing body of "Lords and Gentlemen," known as the Local Government Board, who "come like visions, so depart;" but the attention of the Whitehall Ghosts* has been called over and over again to these defects, until local authorities, who can afford it, are driven, in despair, to supplement the Public Health Act by numerous local private Acts to obtain those powers which the Imperial Government fails to grant to the country at large. While grasping after the shadow of party politics, we are losing the substance, the "salus generis humani."

But accepting legislation as it is, how frequently is it a dead letter? There are those who, in the language of the Royal Sanitary Commission of 1871, are "interested in offending against sanitary laws, even amongst those who must constitute chiefly the local authorities to enforce them." What was true in 1871 applies in 1885. The notorious Clerkenwell Vestry, to wit. In the remote borough, previously referred to, the site is honeycombed with the most offensive overflowing cesspools, under the very windows of closely crowded cottages; some of this filthy property is owned by members of the sanitary authority; Aldermen who sit on the magisterial bench, upon whose favour the local officials are dependent, and against whom it would be not only useless, but folly for an officer to take action. Of another district, near the Metropolis, within the last fortnight one thus writes to a daily paper: "for years the district has been a gold mine, a happy hunting place, full of game for surveyors, lawyers, contractors, and jerry builders. The land speculator flourished, and the leasehold system prevailed; bye-laws infringed by a member of the board, with the knowledge of the board and its officials, bye-laws broken by friends of the members, openly." Yet another instance, adjoining the Metropolis, in an important district where buildings are proceeding very extensively, the model bye-laws of the Local Government Board have been adopted, and the surveyor has been honestly endeavouring to enforce them, but the speculating builders have

* Sir Charles Dilke, late President of the Local Government Board, in a subsequent speech at Halifax, October 13th, describes the Whitehall Board as a "Phantom Board," which "was never intended to meet, and which never has met, from the day of its creation to the present time."

succeeded in returning a majority of their own class as members of the board to frustrate the action of the surveyor, whose master they now are.

In the *Times* of Wednesday, Sept. 15th, Sir Richard Cross is quoted as having publicly stated that a great difficulty in sanitary progress was by reason of so many rookeries being owned by people who were members of vestries, therefore the efforts of subordinate officials were paralyzed. The same letter gives an account of an undrained property, and a windowless dwelling room, recently erected by a member of the Metropolitan Board of Works. In such cases who is to compel the local authority to discharge its duties? What power have dependent officials? Public opinion, is the glib reply; but we, who know, know too well how local public opinion is manufactured, and what interests control it, what false issues are raised, and above all how utterly indifferent the majority are.

The repugnance of self-taxation, is another great difficulty the sanitarian has to encounter. To the mere "ratepayer," sanitary science means officials, public works, and taxation; an investment which gives no dividend — matters which may be postponed. The value of health, comfort, and prosperity, or the loss of labour and waste of capital consequent upon disease and pauperism, are matters of social economy of which the average ratepayer takes no account; he will endure poor-rates, and tax himself for beer, tobacco, and luxuries, but he will not willingly submit to taxation for preventive sanitary measures. What was said by the late Professor Guy, still practically holds good: "Most of our towns, and all our villages, are still untouched by the hand of the sanitary engineer."

But our municipal system and local government is the very essence of our freedom. With all its littlenesses and serious defects, it would be as useless as undesirable to advocate centralisation, which practically means red tape and bureaucracy. But there should be some power of appeal, some authority for regulating local authorities and parish cliques; an authority intermediate between the parish and the Imperial department. Such a body is obviously the long promised county board which, being local and representative, would command respect, and supply the constitutional machinery for regulating the vagaries of ignorant or interested Bumbledom.

But supposing some Utopian sanitary Authority is willing and anxious to discharge the functions for which it is constituted, what is its experience and that of its officers? First, that a cunning jerry builder, with the assistance of a sharp lawyer, can drive the proverbial coach and four through every clause of the Act. In apparently so simple a matter as proving

bad mortar the builder is always ready with plenty of rebutting evidence of other "practical" builders and surveyors with elastic consciences. The author was present in a case where the Justices decided against the Board because the *balance* of evidence was in favour of the jerry builder, who had brought some half-dozen witnesses against the board's surveyor, who, of course, stood alone.

The Local Government Board have issued a voluminous series of bye-laws involving very much detail and official inspection; the advantage of their adoption is manifest, but their adoption is optional, and there is a great difference between adoption and observance. Further, some authorities assume the right to suspend their bye-laws, deciding each case "upon its merits," consequently there is no certainty, and there is possible favouritism. The Local Government Board give no assistance with regard to staff for compelling the observance of their bye-laws. Large towns, such as Liverpool, Manchester, Birmingham, and this borough of Leicester, so ably supervised by its talented engineer, Mr. Gordon, may supply the necessary staff ungrudgingly, but it is not so everywhere. Ratepayers object to staff, but why should the burden be laid on the rates? London, Bristol, Eastbourne, and West Ham provide effective supervision by means of "building fees" imposed under the powers of private Acts; but it is not every town which can afford the luxury of a private Act of Parliament, and Lord Redesdale, chairman of the committees of the Lords, opposes private powers on the ground that if such powers are right and necessary, they should be included in a public Act.

But my "lords and gentlemen" of the Local Government Board, while strongly urging the adoption of their model bye-laws, have no time or inclination to assist local authorities in the means of carrying them out. To the want of a sufficient and an efficient staff is due most of the sanitary defects of the day, defects which could be obviated by better supervision, the cost of the necessary staff being charged upon those who necessitate it—the property owners.

Among the defects in the Public Health Act is the definition of a sewer, especially the exception made in section 13 of the 1875 Act, which may preclude control over a whole estate of streets. Gas and water companies have an advantage over local authorities. No one can touch their mains, but anyone can open a street, break into a sewer and lay a drain, upon giving notice; that is to say, the officer of the local authority must attend anywhere and everywhere, at the bidding and convenience of the builder, to inspect his drains; very frequently when the officer attends the work is not ready for inspection;

in fact, he may attend half-a-dozen times before the work is ready, but if the officer is not there at the right moment the builder will complain of delay and hasten to fill in his trench. Great indignation is sometimes expressed against the local authority for permitting, as sometimes occurs, a new house to be occupied, without having the drains connected with the sewer; it happens thus—a builder is under no obligation to lay his drains at any particular time. When his plans are passed, he can begin when he likes, suspend building, and recommence at his convenience. A jerry builder puts off till the last any expense he can avoid, laying the drains from the house to the sewer, is an expense which he constantly postpones, until one day, finding a tenant, he lets his undrained house. Unless the surveyor watches these houses day by day he will be defeated. It should be within the power of the sanitary authority alone to break into sewers and execute outside work, as in the case of gas and water companies' services, and it should be an obligation on builders to lay the drains as the first work in a building.

There is no power to require a certificate of the sanitary condition of a new house before occupation. There is no power to regulate the minimum height of living rooms. There is no power to regulate timber round fire-places. There is no power of control over additions and alterations to new or old buildings, an omission which may render all previous supervision nugatory. A party wall, a chimney, a window may have been finished yesterday in accordance with every requirement of the bye-laws, and altered and cut about to-morrow without any power of interference. There is power to require the supply of water to a house, but not to a closet, nor power to prevent the pollution of drinking water. There is not sufficient control over a system of combined back drainage on private premises. The provisions for compelling owners to make up private streets are of the most unjust and unsatisfactory kind.

Whenever there is an epidemic, or a cholera scare, people and the press, at other times utterly careless of their institutions and representation, become hysterical as to local management and local officials. With regard to the officials, the author's experience of a very large number with whom he is brought into contact is that they are active, competent, and interested in their work. The critics would do more useful work were they to direct their attention to the defects in legislation, and to the composition of the bodies under whom officials have to act.

But after all is said about legislation, local bodies and officials, by far the greatest impediment to sanitary progress is to be found in ignorance and self-interest. We have much

more to hope from education than legislation or officialism. How difficult it is to obtain observance of the most simple and obvious sanitary rules in one's own house. We may provide the cottage with the most perfect sanitary appliances, but all is set at naught and misused through carelessness and ignorance. The principles of sanitation is a vital subject, which should be taught in our board schools, our grammar schools, and our colleges. The public is being taught by the Sanitary Institute and kindred bodies. Neither public officers, local authorities, nor parliament, can accomplish reforms which should arise in ourselves. The efforts of the sanitary engineer, the medical officer, and the sanitary inspector, will miss their mark unless assisted by an intelligent appreciation of sanitary principles by the population at large.

Sir CHARLES CAMERON (Dublin) said Ireland appeared very much in advance of England in regard to sanitary legislation, inasmuch as the difficulties pointed out by Mr. Angell did not exist in the Irish Public Health Act. If existing legislative enactments were properly administered it would be found to be quite adequate. Local authorities ought to do all that was necessary by means of a set of bye-laws, for which provision was made in the Act. If the existing Acts fully worked were found inadequate, then it would be time enough to apply for new measures.

Captain DOUGLAS GALTON, C.B., F.R.S. (London), remarked that it was essential to efficient sanitation that the people should see that existing powers were enforced. He commended the provisions of the Bill introduced towards the end of the session for the housing of the working classes, believing it would do more to promote sanitary progress in this country than any Act that had been passed in previous times.

Mr. H. H. COLLINS, F.R.I.B.A. (London), said that the clauses of the Metropolitan Building Act, the Metropolis Local Management Act, and the Public Health Act, were, in his opinion, sufficient to meet most of the cases referred to in Mr. Angell's paper; that it was undesirable, in his opinion, to introduce more restrictions, by bye-laws or otherwise, than at present existed. With some few exceptions, over legislation would defeat the object which the reader of the paper had in view.

Mr. JERRAM (Walthamstow) suggested that a committee should be appointed to frame necessary amendments to the Public Health Act.

Mr. LEWIS ANGELL, M.Inst.C.E. (London), in reply, denied that he had asked for further legislation beyond the amendment of details he had described, and explained that there were some very important

differences between the Irish Act and the English Act. What he desired was the extension to the country generally of powers at present limited in operation to the metropolis, matters which could not, as suggested, be dealt with by bye-laws.

On "Sanitary Reform and Voluntary Effort," by F. SCOTT.

Is our present rate of progress in sanitary reform satisfactory? We are inclined in England to draw comparisons between our own and other countries in the matter of sanitary arrangements, and generally to the advantage of ourselves. While such conclusions may on the whole be justifiable, it is to be feared that the habit of reasoning thus followed has a tendency to obscure our view of the highest standard of excellence, if not to paralyse progressive effort. It is notoriously difficult to arouse public opinion with us even to a sense of real danger, and neither our government nor our municipal authorities are ever in advance of public opinion. Hence even the threatened visitation of the country by cholera is not enough to spur the great majority of sanitary authorities into active preparation for such a contingency.

In some few cases where the authorities are urged on by voluntary societies, or where the intercourse with infected districts is so direct as to render the proximity of danger exceptionally vivid, precautionary measures have been taken; but in the great majority of inland sanitary districts the most that has been done is to issue a handbill or poster giving directions for the guidance of householders in case of the appearance of the disease. This action is almost invariably due to the zeal of the Medical Officer of Health, and, in several cases, the Boards who issue such instructions, to my knowledge, fail to set an example to their ratepayers in the matter of removing filth from the neighbourhood of dwellings. The total absence of organisation for the provision of hospital accommodation to meet the requirements of an epidemic of cholera is another instance of the apathy of sanitary authorities.

At the risk of appearing to ignore the fact that I am addressing an audience including many veteran sanitarians, I must, for the sake of sequence of argument, make one or two general observations that are of a somewhat elementary character.

Assuming that all Local Boards and Town Councils were irreproachable as regards the execution of the powers delegated to them, there would still be a vast field of labour upon which it would be out of place for constituted authorities to enter,

viz., the reform of the habits of large masses of the community —habits which are the result of utter ignorance of the laws of health. Such habits, to wit, uncleanliness, intemperance, thriftlessness and vice in various forms, neutralise many of the advantages which, but for their existence, would certainly be derived from recent sanitary legislation. The reform of such habits, as an educational work, is essentially the function of voluntary effort. I do not, of course, allude to the training of the young. The more perfect system of education now in operation under state control (and I may here notice with satisfaction the steadily increasing introduction of hygiene as a subject into the curriculum of schools) may be expected to effect much that has hitherto been left to the efforts of philanthropists; but, just as in the past, much voluntary effort for the improvement of the condition of the masses has of necessity been confined to the aim of preventing the "residuum"—a class hopelessly past improvement—from recruiting its ranks from the class immediately above it, so now must all possible effort be directed to perpetuating the influence exerted in the schools, by removing the counteracting influences in the children's homes. It must not be forgotten that even while school days last, home influences still operate perhaps more powerfully than school teaching, and, as the great majority of the children of the working classes are obliged to leave school at an age when they are most impressionable, their surroundings at the time will soon determine their settled habits. Thus, unless those grown-up, who are susceptible of good influence, are educated in the laws of health (and this is beyond the scope of school boards), the general improvement of habits inimical to health may be indefinitely delayed. For the past eleven years I have been actively associated in an official capacity with the oldest health society in the kingdom—the Manchester and Salford Sanitary Association,—which is still as vigorous and efficient an organisation of its kind as exists, and during that period I have, as a matter of course, closely observed the condition of my own locality, and watched with interest such indications as presented themselves of sanitary improvement or otherwise in the country generally. The conclusion that has steadily forced itself upon me is that the volume of voluntary effort necessary to supply the deficiencies of rate-supported organisation for sanitary purposes throughout the country, is sadly inadequate.

In support of this opinion I may quote the death-rates of all England and Wales for the past 25 years—a period during which a comparatively great development of public interest in sanitary matters has taken place—and during which "a policy of sewage" has been the pride of successive governments. A

reduction of 1·6 per 1000 in a quarter of a century is not a great achievement.

ENGLAND AND WALES.

Years.	Death-rate.	Years.	Death-rate.
1860	21·2	1873	21·0
1861	21·6	1874	22·2
1862	21·4	1875	22·7
1863	23·0	1876	20·9
1864	23·7	1877	20·3
1865	23·2	1878	21·6
1866	23·4	1879	20·7
1867	21·7	1880	20·6
1868	21·8	1881	18·9
1869	22·3	1882	19·6
1870	22·9	1883	19·5
1871	22·6	1884	19·6
1872	21·3		

In view of these facts I am glad of the opportunity kindly given me of submitting for consideration at this Congress, two proposals, the carrying out of which is, in my opinion, calculated to remedy the existing state of things; and I trust that if they do not meet with the support of the Congress, at least the discussion will elicit some practical suggestions for a forward movement. The proposals are—

1. The union of existing sanitary agencies and formation of new ones.

2. The co-operation of the Church in the promotion of sanitary reform.

It seems to me that the formation of a powerful league of existing organisations is a necessary first step. At present persons in various localities who may be wishful to form societies for the purpose of spreading a knowledge of the laws of health have no centre to apply to for guidance and aid in organising. The Manchester and Salford Sanitary Association has supplied copies of its rules and publications, and given advice in many instances, and doubtless other kindred bodies have done likewise; but the details of organisation are, to all but those specially constituted for such work, a great barrier, and nothing short of actual personal help, such as is given by the large temperance, ecclesiastical, and other societies, will do. No existing organisation professes to supply such aid. A Sanitary league, each branch of which would retain its autonomy, would supply the want. The propagandist work would be directed

from the central office in London, and the Sanitary Institute would, if willing to undertake the work, be the natural centre of operations. This league would send out lecturers to break new ground, provide the help for preliminary organisation, supply publications for distribution at a cheap rate, provide lecturers and the appliances for illustrating lectures, circulate the publications of individual branches amongst others, and supply information to various branches on Parliamentary proceedings and other matters upon which it might be desirable to agitate. The branches would organise public meetings when required upon important questions affecting public health, and the central office would focus the influence of the various districts in making representations to Parliament. There are numerous kinds of sanitary reform of great practical importance which might be actively promoted by such an organisation in districts which cannot now be reached. As one instance out of many may be mentioned the excellent movement recently initiated by the Worshipful Plumbers' Company of London, with the object of elevating the status of plumbing as a craft, and by the examination and registration of plumbers securing uniform excellence in a class of work which has long been responsible for much mischief. In Manchester the Sanitary Association promptly recognised the value of this movement—inaugurated at the Conference of Plumbers held at the Health Exhibition last year, and is now co-operating with the Plumbers' Company in arranging for the extension to Manchester and Salford of the proposed system. I would here parenthetically suggest that the Sanitary Institute should recognise and help forward this movement. With such an organisation as I advocate the same action would simultaneously be taken in many of the towns.

I may also mention, as a substantial advantage of such federation, the increased interest likely to be taken in the Annual Congress of the Sanitary Institute, which would doubtless be attended by delegates from many of the branches, and thus attain to much larger dimensions than at present.

But, it may be urged, it would not be feasible to form active branches of such a league except in populous places. If only that result should be attained it would be a great advance; but my second proposal indicates a practical method of spreading a complete network of sanitary organisation, not only over the country districts, but over the towns as well. There is a good deal of sanitary work done by the clergy *con amore* at present, but its results fall immeasurably short of what might be accomplished through the Church by organised effort. Just as in the case of the temperance movement, there were many ardent

temperance advocates among the clergy prior to the formation of the Church of England Temperance Society in 1862, their efforts were comparatively futile; whereas the strength gained by combination of forces and united systematised action has, owing to the admirable organisation of the Church, enabled that society to contribute more perhaps to the marked advance of the Temperance cause than any other kindred body. It is not proposed that a new society should be formed—that is unnecessary. I can see no substantial reason why the Church Temperance Society should not embrace a Sanitary Reform branch, or that the title of the society, which has already been twice altered, should not once more be changed, say to the Church of England Temperance and Sanitary Reform Society. There are doubtless many churchmen, as well as members of other denominations, who do not feel disposed to subscribe to the requirements of some temperance societies, but the basis of the Church Society is wide enough to provide for even non-abstainers who are willing to "*aid in promoting temperance and removing the causes of intemperance.*" This is a pledge that no earnest sanitary reformer need hesitate to take, and consequently there is no objection from the sanitarian's point of view to utilising the Temperance organisation intact for the branch of work in which he is specially interested. To show that the undertaking of such work would not be quite foreign to the aims of the society, I may mention that almost from the outset of its existence certain purely sanitary objects were regarded as within its scope. In a little pamphlet by the Rev. Canon Ellison, entitled, "Twenty-one years' work of the Church of England Temperance Society," it is stated that after some ten years' experience, the promoters of the society were convinced "that if any work of national reform was to be accomplished, something more than mere Total Abstinence Societies would be needed. *The causes of intemperance would have to be attacked.*" Amongst these were included "bad houses, bad water, bad sanitary arrangements, and want of proper places of recreation and amusement." These conditions, it is needless to say, still largely exist (forming indeed a comprehensive sanitary programme), and therefore the society would in no way depart from its legitimate path by undertaking as a prominent feature of its work the promotion of sanitary reform. Indeed it would, I submit, as a matter of policy be a very wise step to take. The obvious importance of sanitary reform in facilitating the spiritual ministrations of the Church, would turn the scale with many clergy not now possessing branches of the society in their parishes in favour of organising them. The society would also attract to its standard many other new adherents engaged in a kindred kind of work,

and once there, the steps to the more advanced temperance pledges would be easy for at least some of them. The meetings of the society's branches too would increase in interest, owing to the variety of lectures introduced, and, most important consideration of all to the society, it would be enabled to cut more effectively than it has done hitherto at what it recognises itself as one of the chief causes of intemperance. The great importance to the cause of sanitary reform of securing the extensive co-operation of the Church, will readily be seen when it is considered what great moral influence the clergy wield, and the numerous means available in connection with parochial organisation, such as district visiting by ladies and others, sick nursing, mothers' meetings, clothing clubs, &c., for spreading sanitary knowledge, and for practically starting persons in improved habits, and encouraging them in their continuance.

Of course the Church organisation could not conveniently be affiliated to the league suggested in my first proposal; but it would naturally work hand in hand with it as it does now with other temperance societies, and that would practically amount to the same thing.

In submitting these proposals, I have purposely abstained from discussing details such as financial responsibilities, &c. Those would have to be worked out in connection with the consideration of various questions that would arise in the process of organisation, but the main object to be kept in view would be to attain the most efficient machinery at the least possible cost. If the Congress approve of the proposals, I would suggest that the Council of the Institute be recommended to take prompt action in ascertaining the feeling of the various sanitary organisations and of the Church of England Temperance Society respectively towards them.

On "Sanitary House Management," by DELORIAS, COUNTESS DE VIESCA.

LADIES AND GENTLEMEN,—In venturing to come before you with some suggestions on the above rather wide subject, it seems proper to show first in what way a lady can have any claim to air her own opinions on matters which more particularly belong, or at least are supposed to belong, to the other sex.

Ladies are not sanitary engineers, and the writer has no wish to claim any exception to that rule on her own behalf, but she

believes that ladies have some special opportunities which they alone can make use of.

The skill that designs and carries out great sanitary schemes of drainage, town improvement, or healthy house building, is able to go no further than to complete these schemes and have them in good working order, their practical success is dependent on the good or bad use that is made of the facilities that engineering or architectural skill has given.

Thus, a clever architect may design and build a house with all the appliances that his skill and experience can suggest, and make it a domestic "Temple of Hygeia" in theory, but unless the occupiers are able and ready to put all those clever contrivances to their proper use, and to see that they are always kept to that use, and never allowed to break down through "sheer neglect," that palace of health may become the home of dirt, smells, impure air, and all the evils that follow in their train, ill-health of mother and children, ever recurring sickness, and perhaps death.

It is here that the ladies' functions come in. It is the servants of a house whose properly directed work has to keep it clean and sweet. It is the lady of the house only who can regulate that labour, and by adding to it her own intelligent supervision can make it effective for cleanliness, and for the health to which that cleanliness is the first and greatest step.

The writer believes that this Institute, numbering members of all classes, lay sanitarians as well as professional, and appealing to all, has peculiar opportunities of educating the public, the dwellers in houses, to their share of that work to which all must lend their individual aid before success can be counted on as certain.

She believes, also, that when the ladies—the mistresses of the houses—come to see that they *can* do more and *must* do more than merely call in masons and plumbers when drains and pipes go wrong, and that by understanding the conditions that make them go wrong and avoiding these—they can better secure the bodily welfare of their near and dear ones than a legion of doctors: when the Sanitary Institute has taught ladies this, then it will not only have begun but more than half finished the greatest sanitary work of the age.

The writer is not an English woman, and having lived in Spain and France, and managed her household both in Spain and England, she is able to appreciate the *advantages* which the English attention to sanitary matters gives to residents here.

She knows the hopeless state of dirt and smells produced by the utter absence of any sanitary provision in parts of Spain, and for which the people are now suffering so awfully.

She has been the victim of the ignorance of the use of ordinary closets in Paris, where she has seen a proper range of such closets with the wires all cut to prevent the water being used—the recognised mode of getting rid of the filth when it threatened to overflow being to force it through the traps with sticks.

She has long lived in England and rejoiced in the opportunities given there for those who *will* be and live clean; and yet in England she has seen dirtier houses and smelt worse smells than either in France or Spain, arising only from laziness of servants and want of supervision by the mistress.

The want of proper drains, sinks, and closets is a serious evil, but drains, sinks, and closets, neglected and uncared for may, and do, produce far worse evils than their entire absence; and nothing less than constant supervision on the part of the mistress of the house will secure that attention to the petty and unsavoury details of keeping it clean in all its parts which is essential to health.

The writer refers here rather to the houses of the middle classes than to those of the poorer or working classes, though she sees no reason why these latter should not be kept just as sweet and clean as the former—if only the wives and daughters on whom the duty falls were alive to the necessity, and properly instructed as to the mode of keeping them so, and in this instruction the Sanitary Institute should be able to take a leading part.

Having now, as she hopes, justified the position which ladies should hold in the sanitary army, the writer would give a few simple rules drawn rather from her own experience than from theory, and the value of which practice has shown her.

If asked for any general principle she would say: "To keep a house sweet and clean get all useless scraps and rubbish out of it as quickly as possible, and get all the air and sunlight you can into it. Mr. Matthew Arnold's well-known expression, 'sweetness and light,' with one addition, would well sum up the essential conditions for a healthy house. 'Sweetness, light, and air' should be the watchword for sanitary dwellings."

The English "spring cleaning" is a rather significant expression, and the institution itself, however praiseworthy, gives an insight into the reason of many stuffy rooms and dirty houses. It means in fact that *only* at that solemn function are the rites of a proper "turn out" ever performed.

A healthy house should never need "cleaning," for it should be *kept* clean by daily and constant attention. No dust or dirt that can be removed by brush or duster should remain in a living room over a day, special care being given to all the nooks and corners that so quickly harbour "fluff" and dust.

Carpets should never extend quite to the skirting boards of a room, as a corner and the carpet hem together form a nook which is very difficult to brush out. A margin of stained or varnished floor a foot or more wide does not spoil the appearance of the room, and renders it easy to brush out daily what otherwise can only be got rid of by lifting the carpet. Between the skirting and the floor there is usually a space not wider perhaps than a thick penny, but always filled with dirt. This is best avoided by a small fillet of wood so fixed as to round out the corner, but where this is not done, a thin strip of wood pushed tightly in, or even glazier's putty is a good substitute. The joints of flooring boards should be filled in the same way, and the saving to carpets will soon pay the expense of so doing.

To return, however, to the housemaid's work: *all* the lighter furniture should be moved daily to allow of proper dusting and brushing of the floor below; every place where dust can settle should be brushed, such as tops of doors and windows and picture frames. The old-fashioned plan of scattering tea leaves on the floor before brushing it is very good, as it collects the dust which would otherwise only rise to settle again.

Once a week at least the heavier furniture should be moved and the floor and walls behind dusted; this is best done by "turning out" at least one room daily.

The mistress should not be above using brush or duster herself, and showing her maids how and where to look for and get rid of dust and dirt. They will learn much more quickly and readily by her example than from any other instruction, and if she has china or other fragile ornaments, she will avoid vexatious breakage by showing her servants how to properly clean them. Such things are new to most young servants, and they break more from ignorant handling than from wilful carelessness.

Windows should, of course, be opened and blinds drawn up first thing, and, except in very severe weather, should remain open till the family comes down. Nothing so gives the appetite for breakfast as to come down to it in a clean room filled with sweet, cool, and fresh air.

Books in a sitting room are great collectors of dust where not kept under glass; they should be so set on the shelves that the leather dust flap lies close upon their backs, and it is well to have book shelves only just wide enough for the books to stand, or the space behind gets filled with rubbish and dirt.

In the bedrooms the windows should be opened as soon as the room is left in the morning, and at the same time all the bed-clothes should be turned quite down over the foot of the bed to air, and on no account allow beds to be made at once; they should air for at least a couple of hours before being re-made.

All slops should be carried out and emptied when the windows are opened. The dusting of bedrooms should be done with as much care as the living rooms, and even more attention paid to the beds themselves.

Curtains to a bed are bad for the sleeper, and those who accustom themselves to do without them and to sleep with an open window besides—open for a couple of inches at the top is enough—will reap the reward in pleasant sleep, and wake fresh and without headache.

All ladies should learn how to make beds, and learn it thoroughly, that they may be able to teach, and every now and then they should assist the housemaid to do it, and so secure that the mattress is turned daily, the bed thoroughly shaken up, and each separate sheet and blanket laid smoothly and without a crease, and separately tucked in. Sheets are rarely made long enough; they should never be less than three and a half yards for the lower and four yards for the upper sheets.

The lower sheet should be laid *under* and turned back *over* the bolster. The superior comfort of long sheets and a bed so made must be felt to be appreciated. This is Spanish fashion, and better than the English.

The kitchen is the place which needs the most constant care to keep it clean and free from smells. Here perfect order is a great help to cleanliness. Every pan, dish, &c., used in cooking should have each its own hook or place on the shelves, and should be replaced there as soon as cleaned.

As soon as cooking is over each pan or dish used should be partly filled with *cold* or, if greasy, with hot water, and either carried at once to the scullery or left on the stove for a while to make it easier to clean.

All scraps of food or meat should, if reserved for dog or cat, be put away at once in the larder and not allowed to remain in the kitchen longer than is necessary.

All refuse of any kind that can decay and give off smells such as bacon parings, cuttings of vegetables, potato peelings, &c., should not be thrown into the dust-bin but burnt in the kitchen fire, this gets rid of them in the safest and easiest way; the proper time to burn them is directly cooking is over when the fire is bright and hot, then they are quickly consumed and serve to partly keep down the heat of the fire then no longer wanted.

If care is taken in this way never to throw anything but dry ashes into the dust-bin, and to burn everything that would decompose, no fear need be felt of smells from that quarter, and there is less to be got rid of by the scavenger.

It is needless to speak of the necessity for the most scrupulous cleanliness being observed in the kitchen—that every one knows—everything used in the preparation of food should be thoroughly washed, scrubbed and dried each time it is used, and left fit for use again. Silver sand should be freely used in scrubbing pans, but not at the sink, as servants are apt to do, or it chokes the trap in time.

It should be a rule that nothing likely to choke a trap should be put into the sink—such as hair, or scraps of cloth or paper. Water in which green vegetables have been boiled should never be poured down the house sink but always carried to the yard sink and disinfectants should be freely sprinkled daily.

As soon as the washing up is finished in the scullery the sink should be thoroughly scrubbed out and every scrap of waste removed, and then it should be well sluiced with fresh water; the same attention should be paid to all grates and sinks on which refuse is thrown; if so, no unpleasant smells will be felt. Scrubbing brushes should be used freely throughout, as the cost of them is well repaid by a sweet and healthy kitchen and scullery. Wiping cloths should be plentiful and washed out daily. Everything needed in a kitchen should have its proper place ready to hand and be replaced when done with.

Closets are the housekeeper's *bete noire* and require constant attention. Some forms are better than others, but all can be kept clean and sweet by care and attention if not out of order—and when they are, the sooner the plumber comes the better. Proper brushes are made to clean the basin, &c., and the lady of the house should *see* that they are daily and effectually used. Disinfectant powder should always be at hand and regularly used. Slops from the bed-rooms should not be emptied here, as they too frequently are, but always at the yard sink.

What the writer wishes to impress on ladies who have the management of a house is that all these matters are peculiarly within their province and should not be left entirely to servants. It is the lady's business to see that the work is properly done by her servants—not to do it herself, except in the way of instruction—and if some of the duties are not altogether pleasant, yet let her remember that by seeing them properly done she is helping, as only she can help, to preserve the blessing of a clean sweet house to her family, and in that way securing their health so far as lies in her power, and keeping the doctor out of the house.

The writer trusts that she has shown that the part which ladies can take in the sanitary management of houses is no small one, and her own experience enables her to assure them

that it is one which no lady need be ashamed of or unwilling to take. The complaint so often made of dirty, untidy, and unskilful servants would be seldom heard were ladies to take personal interest in training those who come to them. A good mistress turns out good servants, and may in that way influence the future comfort of many a working-man's home.

Surg.-Major PRINGLE (London) spoke of the paper as a proof of what a lady could do, and said, as Chairman of a Sanitary Aid Committee near London, he could bear out the evidence there placed on record of what ladies could do. He knew that if ladies would help in the work of Sanitary Aid Committees they would be able to do infinitely more than gentlemen, because they could gain admission into people's houses and make practical suggestions which the gentlemen members could not. He could go and do a good deal as a doctor, but ladies were received and confided in, and had the opportunity of giving good and kind advice and of exercising an influence which gentlemen had not. He came across an instance the other day in which the sanitary condition of the closet arrangements corresponded with what was reported in the paper. It was simply distressing, and almost merited a stronger word, and, in his opinion, it would be more honest and fair if the word "water" were left out in the description. It was disgraceful the way in which matters of such vital importance were sometimes carried on in the neighbourhood of London, and he alluded to it the other day at Cardiff as one of the most fertile sources of disease. Men going home after a hard day's work were in a condition peculiarly favourable to disease, and if they returned to houses with such defective sanitary arrangements they ran the risk of being prostrated in the prime of life. The bread-winner gone, he need not detail to them the rest of the picture. It was perfectly true that the wire leading to the cisterns was frequently cut, for he had seen it done. The arrangements in the suburbs of London were made with a view to *economy*, and much too frequently one cistern *over the closet* contained all the water used for drinking and sanitation, and when the wire was cut for the closet water, to save it for other purposes, or prevent waste, the condition of this closet can be better imagined than described. In the cases in which he saw this state of affairs existed he got the wire rejoined, but how long would it remain so? If better arrangements could not be made for the action of water in closets, they had better call them simply "closets." With regard to drains of houses, he wished to lay stress on this, that it was just as important for masters of houses to see that their servants were as well, comfortably and sanitarily housed downstairs as the occupants upstairs. If sickness got into the lower parts of the house it would certainly find its way upstairs. In a case where he was consulted the other day the closet arrangements for the

servants were very defective. The engineer attributed it to a lack of cleanliness, but it was found to be due to a disconnection between the basin and the trap, due to the corrosion of the connecting solder, and yet the sanitary inspector called this a water closet in a dirty condition.

Mr. A. M. FOWLER, M.Inst.C.E. (Leeds), said that as a family man, and having experience in sanitary work, it was with infinite pleasure that he heard the paper, because, unless the ladies assisted, he thought their results would fall very far short of the objects they had in hand. He considered one point in the paper very important, and that was the filling up of corners and the joints in floors with putty. They all knew that the germs of contagion were passed from one room to another by the floating motes, and the smallest particles that could not be seen in the ordinary light, but could be seen through the prisms of the sun's beams. They were told there was no contagion of typhoid fever unless they took up some particle that had passed from the body of a patient, and therefore they should be very careful that no particles that came from a sick room passed to other members of the family. If the joints of boards were left open, and dust allowed to accumulate in the corners of rooms, it seemed to him that there must be danger. In following out that view they must come to the conclusion that they had not arrived at the proper standpoint with regard to floors and joists in house building to secure perfect sanitary precautions. It was far better, in his opinion, to construct houses something like the buildings in Victoria Street, Westminster, perfectly fire-proof, iron joists and concrete floors, where not a particle of dust could accumulate or be hidden away: thus making a great stride in sanitary reform. Take, for instance, the case of old property, where death most frequently occurred from emanations. Filth got between the joists, and as time went on it was wafted out again. Builders would not complete the sanitary arrangements of houses, nor do all that was possible to help the housewife to keep them clean if they did not build so that the joists and joints in the floors were made as secure as possible against dust and dirt. With regard to burning up the rubbish in a house, it was already done to a limited extent, but it could not be done thoroughly on a large scale.

Dr. W. J. SIMPSON (Aberdeen), said it was with extreme pleasure he had listened to this admirable paper. The Countess had touched upon one point that really needed reform, and that was cleanliness in the household. No one could exert so much influence in that direction as the ladies. He had often been struck with the aptitudes of servants for putting forty things away in corners—under the staircases and in out-of-the-way places. So that many houses, although apparently clean, tidy and well ventilated, had in these hidden places accumulations of filth that promoted disease. The remarks regarding the turning back of the bed-clothes and bedding so as to allow the whole bedding to become well aired, were very appropriate; no room should be more attended to in respect of ventilation and cleanliness

than the bedroom. Another thing which he had often noticed was that some ladies seemed to think that if a smell proceeded from a sink they could get rid of it by putting a cover over it, showing how little they knew of the diffusion of foul air. It was easily observed how different was the household of a lady who knew something of sanitary principles, as compared with that where there was no such knowledge. The proper training of servants was one of the directions in which ladies could exercise great influence. They had the training of servants who ultimately became the wives of the working men, and carried their habits of cleanliness to the poorer houses. He hoped that more would be done in that direction in future.

Mr. WALTER ROWLEY, M.Inst.C.E. (Leeds), remarked that the remedies for the evils to which their attention had been drawn appeared exceedingly clear and useful for the purpose. The only difficulty that occurred to him was the practical application of the same. He was one of those unfortunate individuals who built a house and attempted to apply hygiene and sanitary law to such an extent as to ensure the health and happiness of the household. The result was that within the last few weeks all his servants had given notice to leave, and distinctly stated that they had not been accustomed to the personal interference of the master and mistress in the sanitary arrangements of the kitchens and outbuildings, and the duties of the housemaid in respect of the sleeping and living rooms. They said even more. The senior servant announced that no experienced servant from a good house would ever come to a house where they were interfered with in a manner so totally different from what was usual elsewhere. He should like to know how such a grave difficulty was to be dealt with. He feared it could not be met until they had a new generation or race of servants brought up under a superior code of training, and therefore mutually interested in promoting views calculated to secure a healthy household. The cry was of course to train servants to know how to deal with these matters, but at the present time they refused absolutely to be instructed or even controlled in any way in these matters, and if we had to wait until a new generation was born who would not mind learning, he was afraid the tenour of their lives would not be as happy and of as long duration as was desirable. Respecting the closet difficulty, he thought he had been successful in dealing with this leading question. His plan secured good internal convenience and external sanitary advantage, by making a covered way to the earth closets, which were situated at an extreme point beyond the living part of the house. By this arrangement the difficulty had been bridged in a manner most satisfactory to every member of the household.

Mr. JERRAM (Walthamstow) said it seemed to him that teachers in the board schools thought it beneath them to teach the children the use of sanitary appliances. He suggested that in both the higher grade and board schools the questions set forth in the paper should be taught as a part of the regular education of children. He had

visited board schools where the sanitary appliances were disgraceful, and if children left them to enter service in large houses, imbued with the ideas they picked up at the board schools, he did not wonder at the ignorance shown by domestic servants.

Dr. J. F. J. Sykes (London) added his tribute to the very excellent paper that had elicited so much discussion, and said it confirmed what he had heard over and over again at these Congresses—that they wanted better teaching among domestic servants. It was really a very serious matter. He quite confirmed what Dr. Pringle said. He (Dr. Sykes) had a district under his care with a quarter of a million of inhabitants, and one inspector's time was taken up by making orders to keep the connection between the closet and the water supply cistern. It was quite cruel the way people broke the connections, but the magistrate was always severe about it. There was one little exception he took to the paper. It was regarding open windows. He did not believe in open window tops in this country; people would not open their windows, they would not do it in the middle of winter. There was an excellent remedy for this, and very easily applied. It was to make the bottom bead of the window overlap the bottom of the sash. If the bead were wide enough, they could open the bottom instead of the top and have no draught. There was no mention in the paper of disinfectants in case of contagious diseases, but possibly that was trenching on the confines of medicine. It appeared to him that all disinfection should be done by municipalities gratuitously. Anybody in his district who liked to send could have his room completely disinfected without expense to the householder. It was an excellent system because it encouraged people to have it done, whereas if they had to pay to have a room disinfected they were not so ready to do it. It was also an advantage to the municipal body to have it done, and they absolutely saved the pockets of the ratepayers by preventing the spread of disease. With regard to plumbers being called in, his experience was that they generally made matters worse. The plumbers' guild was taking the matter up, and now they were doing better work; but he thought that ladies should not trust altogether to the plumbers.

Mr. Scotton thought that the one practical thing to consider arising out of the paper was the training of servants. How this was to be done was the great question, and the suggestion that board schools should introduce the system was a practical one. But something more than that should be done, because the bulk of the servants had passed school age, and he thought some system of voluntary teaching was necessary, and something practical in that direction should result from the Congress. It would be well if ladies in country districts would bind together, as they did now for teaching sewing and the like, to spread a knowledge of simple sanitary laws among those who were intended for domestic service.

Mr. Ellice-Clark, M.Inst.C.E. (Hove), thought they should thank

the Countess of Viesca for her courage in bringing forward her paper, and also for having laid down some simple rules, which, if attended to in all houses, would no doubt produce excellent results. It was a great thing that a lady should first take the trouble to prepare a paper, and secondly, that she should deal with subjects which a few years ago would have been tabooed, not only amongst ladies themselves, but also amongst gentlemen in the presence of ladies. A great deal of the discussion had turned on the training of domestic servants. He was engaged professionally in Brighton, where a comparatively larger number of domestics were kept than in many other towns. It was lamentable to see the difference there was between houses where the mistress took an interest in the cleanliness of the house, and where they did not. With regard to the teaching of the uses of sanitary appliances in schools, he thought that a question to which the attention of female teachers should be directed.

Mr. J. Horrocks (Southport), suggested that the paper should be given away or sold at a cheap rate for a number. He believed it would be read more eagerly by English people, because it was written by a foreign lady, and would thus be the means of disseminating sanitary knowledge amongst the very people it was necessary to instruct. He should be very pleased to have copies printed (if per-permission from the Institute were given), and to distribute them in his district.

Mr. S. J. Barber (Eastwood) believed that many of the evils complained of in the paper admitted of remedy, and that it would be a good thing if the walls, ceilings, and floors of houses were made non-absorbent, which could easily be done. One great evil in the ordinary floor was that it retained moisture for a long time, which was not healthy, especially in bed-rooms. If it were coated with enamel paint it would be perfectly non-absorbent, and would be quite dry after washing. Open joints in floors could in future be avoided if the boards, before being laid, were submitted to a process of seasoning by dessication, a system lately introduced. If ceilings also were coated with paint or enamel a little water would make them clean, and there would be no necessity for white-washing or colouring, and nothing noxious would be absorbed. The ordinary wall papers are very objectionable, as they absorb and retain effluvium for a long time; it would be much better to use paint, or some of the non-absorbent decorations now manufactured. The sink in the kitchen was generally one of the most disagreeable objects in the house. If made of enamelled earthenware, they should be perfectly sweet if properly trapped.

Mr. J. Lemon, M.Inst.C.E. (Southampton), drew attention to the ignorance of the ladies in the middle classes as to the management of their homes. He thought it should be generally understood that in order to have a good healthy house the lady *herself* must be conversant with the details of the management. If this were a little more known

and attended to it would be better for all concerned. Carpets all over a room were a great mistake. Then as to disposal of refuse, he was in favour of sweeping away dustbins altogether. They were wrong in principle. The cardinal principle he laid down was—rapid and continuous removal; and they could only do this by having proper receptacles, to be emptied by the scavenger as soon as possible, and not allow the refuse to accumulate in the vicinity of the house.

Dr. Dolan (Halifax) remarked that the want of proper drains, sinks and closets was a serious evil. He wanted to say a few words as regarded practical legislation in reference to who was to put drains and sinks in order, because he believed that until they had some legislation of the kind all the efforts of sanitary reformers would to a certain extent be impeded. He had spent on his house something like £50 to £70 on improving the drainage, as the landlord declined to do it. Until the law was altered so that landlords were compelled to put houses in a good condition, they were virtually in the hands of the landlords, and in many cases needful sanitary reforms were not carried out because the landlord would not do them, and the tenant could not afford to.

Mr. W. R. Maguire (Dublin) said he always thought, but now he felt sure, that the Sanitary Institute made a great mistake in not endeavouring to induce ladies in the different towns where Congresses were held to come forward prominently and assist in sanitary reform. No doubt ladies required some courage to enable them to bring forward such subjects and offer their advice in a mixed assemblage, but the admirable manner in which the Countess de Viesca had treated this important subject in her interesting paper, might be taken as a model and afford encouragement to other ladies to give the Institute at other Congresses the benefit of their special experience. Some of the speakers seemed to think that suggestions as to the form or construction of the various sanitary appliances should have been offered, but they should remember that the Countess' paper had been written on "Domestic Sanitary *Management*," and not on Domestic Sanitary Engineering.

Sir Charles Cameron (Dublin) said he did not think he had ever listened to a paper in which more home truths were put before them in so small a compass. He quite endorsed all that was said in it, and did not think it was open to any hostile criticism. He believed himself it was better to allow dust to remain harmlessly on the shelves and furniture than to disturb it over the whole room with a brush, rendering the atmosphere extremely unpleasant and even sometimes dangerous. He was in favour of the immediate removal of filth. Even to deposit it in the ground near was dangerous, because it so happened that the atmosphere of their dwellings was very much affected by the condition of the atmosphere of the soil beneath them. There was an atmosphere extending to some 60 or 70 feet below the soil, and it had a tendency to be diffused up into their houses. If the soil about their houses

were impregnated with filthy matters which were so often carelessly thrown out of houses, the air below the soil became polluted and dangerous, and that entering the houses frequently carried the germs of many diseases into their dwellings. He cordially endorsed everything the Countess had said about bed curtains, and also about women's mission in sanitation, believing that women sanitarians could exert great influence. They had a Ladies' Association in Dublin, and he had many opportunities of seeing the good work they did. The improved condition of the houses in the district in which they worked and improved manners of the people, were seen at once. A benefit was also noticed in the improved diet of the working classes, and he believed women were as capable as men of giving sound sanitary advice.

On "Ambulance Work," by J. H. Buckley.

On Oct. 19th, 1880, the late General Burnaby and a few friends interested in the St. John Ambulance movement met at the house of Dr. Buck to arrange for the first public meeting in connection with the movement, and to form a committee for carrying on the work, more particularly in Leicester itself. A *Leicestershire* centre had been formed some twelve months previous, but it was desirable for the more efficient working to have a local committee. When we look at the names of the ladies and gentlemen who rallied round the movement at this juncture we can hardly wonder at the impetus given to the cause. We refer to Dr. Buck, General Burnaby, Captain Grimston, Captain Rolph, Captain Watson, Mr. Farndale, Superintendent of Borough Police, Rev. and Miss Fortescue, the Misses Fullagar, &c. The first public meeting was held Nov. 6th, 1880, in the Lecture Hall, Museum Buildings. Colonel Duncan, C.B., R.A., came as the deputation and presented the certificates. Among the recipients we find the Countess of Lanesborough and Lady King-Hall. Most of the work of lecturing to the classes had been done by Dr. Buck, but as the work grew it became necessary to seek further help. Accordingly eleven of the medical men were applied to for assistance. Only four came forward to offer their services gratuitously. To these gentlemen, Mr. Greasley, Dr. Buck, Dr. Moore, Mr. Douglas, and Mr. Everard, much

of our success to-day is due. Some of the local medical gentlemen, while not able to assist by lectures, have lent their moral interest, and given us their sympathy, whilst one—Dr. Pearce—has placed at our disposal a skeleton to illustrate the lectures. The effectiveness of our earlier operations was felt to be considerably marred by the utter want of any organization or inducement to keep together those who had gained certificates, so that they might maintain a practical acquaintance with the work expected from them. The thought occurred to Mr. H. Brice that a corps, formed upon somewhat similar lines to the Volunteer Fire Brigade, would answer the purpose—every member to hold himself in readiness to render any assistance in his power when called upon, without fee or reward; and in order to maintain a thorough state of efficiency, to meet once a month for practice, and to have an occasional lecture from a medical gentleman. A preliminary meeting was summoned to meet at the High Cross Coffee House in November, 1882, at which a committee was appointed to draw up rules and get out a circular, to be sent to every medical gentleman in the town asking for suggestions, so that the undertaking might be established on as sound a basis as possible.

Thus was formed the nucleus of a society which has done much to popularize the movement in Leicester. An indispensable condition of membership being the possession of a certificate from St. John's Gate.

From this time the progress of the Ambulance movement has been steady and eminently satisfactory. At the commencement of the year 1882, as will be seen from the statistics, the Society was so crippled for want of funds that less work was accomplished than in any year of its existence. Appeals were made through the local newspapers. The committee became a body of collectors; concerts were got up by the railway men and the Ambulance Corps, and such a vigorous effort was made as to bring an accession of funds and an influx of persons anxious for instruction; the result was that in 1883 our work exceeded that of any previous year—223 gaining certificates, this being 30 in excess of our hitherto highest record. The percentage of certificates gained in proportion to the numbers examined was greater than ever. This end was mainly achieved through the assistance of the Ambulance Corps, detachments being told off to attend each course of lectures to assist the lecturer in the practical demonstrations. Here our strength and power for good lies. In this work as in yours, gentlemen, theory without practice is comparatively useless. In all our examinations the ability to put on a bandage or a splint in the proper way and in the right place is accounted far more

valuable and important than the knowledge of names of arteries, veins, or bones. One great feature of our work has been the instruction of the members of the police force and railway servants—two classes of men who often hold the lives of their fellows in their hands. Here success has crowned our efforts in a marked degree, no fewer than 129 policemen and 130 railway servants have gained certificates, while more than twice that number have been under training. Early in 1884 a separate corps was formed, composed solely of railway servants, and provided with stretchers, splints, bandages and tourniquets. By the kindness of the officials, arrangements are made that in ten minutes from notice being received of any disaster on the line, a company of twenty efficient men can be dispatched to wherever their services may be required. While the Railway Corps have thus shown their zeal and love for the work, the Town Corps have not been idle. The need of an Ambulance Carriage for the removal of the injured, or of patients suffering from non-infectious diseases had been long felt. Several cases having come to the knowledge of the committee where persons suffering from serious fractures had been placed in peril from being thrust into cabs, it was determined to set to work at once to raise the necessary funds. By subscriptions, and a sum raised at a concert where all the performers gave their services, the amount required was procured and the carriage was presented to the Mayor and Corporation, for the use of the town, in November last. We need hardly say it has answered all our expectations. Not content with this, another vehicle, to be drawn by hand, has been invented and built by members of the corps. It is intended to place this in a populous neighbourhood for the use of the poor. The experiment, it is hoped, will be but an instalment of a scheme to provide something similar for every poor centre in the town. As such, it will be watched with keen interest by many.

We must not omit to mention the latest local development of the movement. For some years past efforts have been made to obtain an Ambulance Corps for the volunteers, but not till last November did it become an established fact. Ten members of the Town Corps, including the president and vice-president, were duly accepted and sworn in. After the usual drill, they were apportioned amongst the head-quarter companies. In the first week of August they accompanied the regiment to the camp at Blackberry Hill, and did good service. We can hardly refrain quoting from a letter sent by the Colonel of the regiment to the Sergeant in charge: "I saw enough of them in camp to be sure that wherever they are they will do credit to the battalion under my command."

The following figures show the work accomplished:—

	MEN.			WOMEN.		
	Recd. Inst.	Cert.		Inst.	Cert.	Advcd.
1879	142	35		98	23	...
1880	181	28		79	55	...
1881	182	118		141	44	37
1882	25	15		62	30	22
1883	208	159		112	47	17
1884	232	158		200	49	17
	970	513		692	248	93

For 1885, our returns are not yet complete, but we have a grand total of nearly 300 certificates to be presented at our annual meeting on October 15th.

Undoubtedly this represents a large amount of work on the part of committee and lecturers, and the question may be asked, *cui bono?* A mere cursory glance at our occurrence book, in which *some* only of the cases are entered, will show. We select a few haphazard:

1. A policeman found a woman in the canal. On getting her out of the water she was apparently dead. By his unwearied exertions she was, in the course of half-an-hour, restored to consciousness.

2. A boy carrying some sheets of glass up a ladder, fell, the glass severing the brachial artery. A member of the corps stopped the bleeding and saved the lad's life.

3. Once more. A navvy engaged on the flood scheme was passing down Belgrave Gate, and accidentally severed the left brachial. A member of the Railway Corps happening to be just behind, sprang forward, and grasping the man's arm, compressed the artery till a tourniquet could be improvised, when the man was conveyed to the infirmary. The house surgeon told him whoever had put up his arm saved his life. The man was father of a family of little children, and his death would have meant the union for the family for years. One life saved is payment for all the trouble incurred. Who can estimate the value of one life? But these are not the whole of the results following, many are not even reported. We ask for your sympathy, gentlemen of the medical profession, and we appeal to your interests. A live patient is surely worth more than a dead one, and our work is only to try and do our best till your superior knowledge and experience can be made available.

Dr. W. Collingridge (London) said that the ambulance movement was altogether a recent one, and one of the most important movements of modern times. From its inception it had had many difficulties to contend with, and first of these that of dealing with the medical men. They were teaching laymen and women to deal more or less with professional subjects, and there was some amount of opposition to start with. He had been associated with the St. John's Ambulance movement from its beginning, and knew how the difficulties had been met in London, as well as Leicester and other towns. The most important point was to obtain the sympathy of the medical profession. It was felt that when they had the medical profession at the head, interested, when once they saw that it was not only for their good, but also for the good of humanity at large, they had got over the main difficulty. Another consideration was whether in teaching non-professional persons to deal with stoppage of bleeding from the main arteries they would not soon run the risk of doing an immense amount of harm. The whole point was the *way* in which this had been met, and the results that had been obtained. He could show from his own knowledge at least fifty cases in which life had been saved by the intervention of ambulance men, and of course there were many throughout the country where weeks and even months of sickness had been avoided by proper and immediate treatment. In ambulance work they taught non-professional persons to deal with cases in such a manner that they might not become worse before professional assistance could be procured. They had not to heal or repair an injury, but simply give it first aid treatment. He had known one or two cases in which injury had been done. He saw one case in which perhaps it would have been better had the patient been let alone, but to one case where injury was done they had fifty where life was saved, and thousands where material benefit had resulted. There were two distinct branches of the movement. One confined almost entirely to men for the treatment of serious accidents on the railway, in streets, mines and factories; the other, which until the last three or four years was neglected, for the treatment of children and accidents in the household, such as burns, scalds, &c., where ladies were useful. Of late years much attention had been paid to the systematic teaching of ladies in the treatment of ordinary every-day accidents. Here was another difficulty. Many persons were trained to treat accidents up to a certain point who did not come across those accidents, and it stood to reason that they were liable to forget what they had learned. To meet that the St. John's Ambulance had instituted a system whereby periodical examinations were held. If a person passed three examinations, and obtained three certificates, he became a permanent pupil of the Association. He particularly called the attention of ladies to the advanced course of nursing, because he considered that for them it was the most important and interesting.

Dr. W. E. Buck (Leicester) called attention to the Ambulance Corps which had been formed in Leicester, which enabled the members

to keep up their practice, and suggested that a corps of ladies should be formed with the same object in view. He also advocated the provision of stretchers in different parts of large towns for the removal of patients, instead of placing them in trucks.

Sir CHARLES A. CAMERON (Dublin) agreed that it was most desirable they should have institutions of this kind throughout the United Kingdom; but with regard to removal of patients to infirmaries he thought it should be compulsory upon sanitary authorities to provide proper conveyances, the same as they did in the case of infectious diseases. The humane removal of sick people, such as those suffering from rheumatic fever, should engage the sympathy of every one, and he did not think it was the office of societies of this kind to provide things which should be paid for by the community at large.

Dr. C. A. MOORE (Leicester) gave instances of successful ambulance treatment of cases which came under his notice at the Leicester Infirmary, and suggested that it would be a good plan if instruction in sanitary principles were associated with ambulance work.

Mr. J. H. BUCKLEY (Leicester), in reply to Sir Charles Cameron: It is impossible to calculate the number of cases in which the members of our different corps have rendered valuable assistance.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Percival Gordon Smith, F.R.I.B.A.

PRESIDENT OF THE SECTION.

The very wide scope of sanitary engineering and architecture with which this Section of the present Congress has to deal, and the comparatively short space of time which is available for the address that is expected of me, preclude me from making any lengthy prefatory remarks, or from offering any apologies for accepting the Presidency of this Section. Indeed, I was hardly aware until I began to consider the matter, how very wide is our range of subjects, and therefore I may, perhaps, be allowed to remind you of some of the questions coming within the scope of sanitary engineering and architecture. They include such matters as—

Water supply to all manner of towns and villages.

Sewerage.

Means of disposal of sewage as well as refuse of all kinds.

Prevention of pollution of rivers and streams.

Preservation of purity of the atmosphere.

The formation of cemeteries and mortuaries, and arrangements for the disposal of the dead.

Open spaces in towns.

Clearing crowded parts of cities and towns.

Providing wholesome dwellings at moderate rents for the poorer classes, in the country as well as in towns.

Then there are innumerable other matters, as abattoirs and slaughter houses, markets, baths and washhouses, free libraries, common lodging houses, crêches, &c., which directly or indirectly affect the health of the people. Beyond these again, we have the intricate detail arrangements for carrying out these several matters in a proper manner, the street paving, scavenging, watering and cleansing; the drainage, water supply, ventila-

tion and other points about our domiciles; the distribution of the various parts of our institutions for insuring the greatest hygiènic advantage, whether in the school, hospital, asylum, prison, barrack or workhouse. All these (and others could be mentioned) are among the subjects which we may have to consider, and I think I have said enough to make you agree with me as to the magnitude of the subject. It is quite beyond my power, even did time permit, to deal in the most cursory manner with all these subjects. I therefore propose to touch upon only a few of them, and in doing so, to endeavour to review very generally the present condition of certain sanitary works in the country—to "take stock," so to speak, though necessarily in an imperfect and incomplete manner, of the work that has been done under modern sanitary legislation; to see how far we are making progress, and whether that progress is such as can properly be regarded as satisfactory.

The legislation of recent years would seem to have given a great impetus to sanitary progress. It is stated in a recent Annual Report* of the Local Government Board that the total amount of loans which were sanctioned by the old General Board of Health under the Public Health Act, 1848, up to 1st September, 1858, when the Local Government Act, 1858, came into force, was £2,956,178, and the sanctions granted by the Secretary of State under the latter Act, and the Sewage Utilization Act, 1865, prior to the date of the constitution of the Local Government Board, amounted to £7,363,366. Thus in the twenty-three years prior to the constitution of the Local Government Board an aggregate sum of £10,319,544 was authorised, while in the first thirteen years of the Local Government Board a sum of **£29,890,353** has been sanctioned in connection with the administration of the sanitary laws of England and Wales, outside the Metropolis. These figures will serve to convey not only an idea of the extent of the works that have been, and are, going on for sanitary purposes, but of the enormous increase that has taken place in such works during the last ten or twelve years. The larger proportion of these amounts, as may be expected, is for sewerage works and water supply, and upon these works alone the amount authorised to urban and rural authorities has averaged during the last five years over 1⅛th million a year. The total amount of sanctions for public health purposes authorised by the Local Government Board averages upwards of 2¼ millions a year, which sum includes, besides sewerage and water supply works, a variety of other matters, such as street improvements, markets, recreation

* Thirteenth Annual Report of Local Government Board pages lxxi., *et seq.*

grounds, disinfecting stations, infectious hospitals, &c. It must further be remembered that these figures represent only the *public debt*, or the extent to which the local rates are mortgaged, whereas there is a vast further expenditure for sanitary works of the kind known as "private improvements"—works of a public nature, but which are not ripe for public use, and for the cost of which therefore the owners of the property to which the works relate are responsible. The outlay upon these has been estimated as equal in cost to that of the public works; and, assuming that that is an approximately correct estimate, we arrive at the enormous outlay of nearly sixty millions in sanitary works outside the Metropolis in the last twelve or thirteen years, or on an average a sum approaching five millions a year. This large outlay, again, is wholly independent of the cost incurred for sanitary improvements in private houses and public institutions, which must be very considerable, but of which we have no means whatever of forming an estimate.

This large increase of expenditure, which falls on the increased population and improved resources of the country, unquestionably represents a vast amount of really useful work. But it by no means represents all the useful sanitary work of the country, for there is other work of much importance which involves practically no cost whatever. The benefits derived from supplying our towns with house to house water supply, and our villages with the more modest main pipes and public water taps and fountains, are indeed great. The advantages of providing properly constructed sewers in our populous places, whether cities or villages, and of disposing of the sewage in a harmless and efficient, if not always in a useful or profitable way, are enormous. The success which has over and over again resulted from the possession of an efficient hospital in which the early cases of infectious fevers have been isolated, so that what might otherwise have become a dangerous epidemic, has been averted, is gradually being recognized, as is shown by the increasing number of hospitals that are being built for the purpose, as well as by the diminishing reluctance of patients to go into them.* The benefits conferred on the communities by the vast street improvements in many populous towns, by the

* In no sanitary district, perhaps, have the arrangements for the isolation of cases of infectious fevers been better managed and attended with more useful results, than in Leicester. The compulsory notification of infectious disease has tended to the isolation of cases in their earliest stage, and the hospital has acquired a reputation for comfort; payment has been regarded as quite a secondary consideration, the isolation of the patients—and indeed of any friends of the patients who had attended them immediately prior to admission, and thereby become a possible source of infection—being the primary object of attainment.

provision of excellent pleasure and recreation grounds, by the construction of good markets and abattoirs, cemeteries and the like, are universally admitted; and indeed it is impossible to form any estimate of the wide extent of the advantages resulting from these important works when efficiently carried out. But there is still other useful work of less costly kind that has made gigantic progress in the last ten or twelve years; I refer to the education of the public in the appreciation of sanitary work of all kinds, which has advanced in a most encouraging manner; without this, I contend, in this country of *local* government, no practical progress would have been possible. The enthusiast may be somewhat disappointed when he sees apathy in regard to health matters displayed by some corporation or local board, or neglect of some important duties, such as the control of house construction for example, or other equally important detail; but taking a broad view of the present state of public feeling on the subject, compared with what it was some twenty years ago, and looking at the improved acquaintance with sanitary matters generally which has resulted from these annual gatherings, from the Health Exhibition and the various local sanitary exhibitions so commonly held, I think we have every reason for congratulation.

It is only about thirteen years since the constitution of the present central authority for the control of matters relating to public health. The Local Government Board Act, 1871, not only constituted that authority, but transferred to it a variety of duties which had previously devolved upon a number of different departments of government, and thus a step was taken which tended to facilitate the controlling of such matters and the discharge of those functions with greater uniformity, precision and certainty than previously. That Act was immediately followed by the passing of the Public Health Act, 1872, but this was superseded by the comprehensive Public Health Act, 1875, which at once put the numerous sanitary laws, which had previously existed in a most inconveniently scattered and dispersed form, into a concrete and manageable shape. It is these Acts, with certain more recent Amendment Acts, which may be said to constitute the machinery by which throughout the country (the Metropolis excepted), all matters relating to public health are controlled. These general Acts have in some places, as in the town in which we are assembled, been supplemented by Local Acts for certain purposes, but this has been done mainly to satisfy local wishes and to meet local circumstances, and though in some instances this shows a commendable disposition for advancement beyond the general laws of the land, and upon some points at any rate is no doubt beneficial, I am

by no means sure that Local Acts have invariably satisfied their promoters, or indeed been commensurate with the large cost involved in obtaining them. An able writer* speaking of these Local Acts, says, "Since the Statute of 1875, as before that date, Local Acts, amending the General Law, in one view, confusing and obliterating in another, continue to be passed. They have arisen, in many cases, from an exaggerated sense of the peculiarities of the town, or a desire to make minute provision by statute instead of bye-law. For some populations it must be admitted that a convenient code in one statute has been thus provided. These codes would be more capable of defence if supplementary Acts for the same town did not so soon rob them of that comprehensive character which is their best justification. For our great towns precision and directness have not been attained by Local Acts, inasmuch as their number and complexity so often reduce the whole to a chaotic state. These Local Acts are unsound in principle, because sold by Parliament for fees, and because in practice, at any rate, they cannot be amended without the employment of legal assistance, which is itself a source of expense." I am bound to express my general concurrence with those remarks, and especially as to the difficulty and expense of obtaining a Local Act as well as of amending it. Whatever can be done by means of bye-laws under the provisions of the general statutes clearly ought not to be embodied in any Local Act. The Public Health Act, 1875, specially provides that bye-laws may be made with respect to new buildings for securing their stability, for the prevention of fires, and for purposes of health, hence none of these matters ought to be dealt with by Local Acts. Proper bye-laws can generally be obtained at little or no expense and in a very short space of time; they can be altered, extended or repealed with the least possible difficulty, and can be so framed as to include nearly every necessary requirement. When these matters are embodied in Local Acts, the details often fail to obtain, in the preparation of the Bill in Parliament, that careful and skilful attention that is requisite. The Local Government Board in their 13th Annual Report observe (page cii.) upon this subject: —"In several Bills which came under our review we found clauses ostensibly designed to secure to the local authority a more effective control over building operations than bye-laws under the Public Health Act, 1875, would enable them to exercise. In many instances, however, it appeared to us that the clauses were of an objectionable character as, while purporting to lay down rules having for their object the prevention

* Mr. Francis S. Powell, Health Exhibition Literature, Vol. II., p. 341.

of sanitary defects in the structure and surroundings of dwelling-houses, they omitted to enforce the observance of precautions which would have a place in any properly framed code of regulations, and in some cases would have prescribed, with regard to such matters as drainage, ventilation, the provision of open space, &c., requirements which we were compelled to regard as tending to perpetuate structural arrangements now generally condemned as sources of probable danger to health." I may state that in recent years Parliament has appointed special committees to consider and report upon Local Bills, and by this means much needless and defective local legislation is arrested.

The education of the public in the appreciation of what is healthy, and in the desire to adopt proper sanitary arrangements, cannot fail to encourage, among other measures of advancement, the adoption and efficient application of proper codes of bye-laws as a means of controlling the details of the construction of domiciliary buildings; and this—the value of which can hardly be over-estimated—is, I think, gradually progressing in a surprisingly rapid manner. Looking back some fifteen or twenty years, how rare was it to find even such common arrangements as disconnected waste-pipes and ventilated soil pipes, arrangements which now-a-days many people look for in one form or another as a matter of course. Then there are the arrangements for drain ventilation, for rendering building sites wholesome, for securing adequate open space about houses, for ensuring a proper kind of closet, proper privies and ashpits, and a host of other details of importance. All these matters can be dealt with in new buildings by means of bye-laws, and although one may regret that so many places retain old-fashioned regulations which are exceedingly indefinite, arbitrary, and often erroneous, it is satisfactory to gather from the annual reports of the Local Government Board that this subject is being taken up by the public in a way which, as it seems to me, is highly satisfactory. In 1877 the Central Board caused to be prepared a form of building regulations which it was suggested should be used by local sanitary authorities as a model upon which to frame bye-laws relating to new streets and buildings adapted to the requirements of their district. This "model" series deals with the various subjects upon which bye-laws may be made, and it contains very complete and definite regulations based upon what are generally recognised as sound principles; and when I say that in the short period of eight years which has since elapsed, the model code has been adopted in a more or less complete form by some 400, or 25 per cent., of the urban and rural sanitary authorities of England and Wales,

I am sure you will agree with me in regarding the matter with some degree of gratification.

In some of these districts I have reason to know that the new bye-laws are found to be working most satisfactorily and without difficulty, and it is to be hoped that wherever in operation they will be intelligently enforced, though I fear, from what I have observed in a few places which possess good bye-laws, that there is much yet to be desired for ensuring their being uniformly and efficiently carried out. Upon this particular point I would observe that the education of the people in the importance of sound and healthy dwellings may be expected to bring about improvement, for at present it frequently happens that, owing to the apathy of the ratepayers who annually elect the members of the local sanitary authorities, the successful candidates are persons who are directly or indirectly interested in evading some of the most valuable bye-laws, with the main object of effecting some saving in the first cost of building. This unfortunate circumstance which, so far as certain sanitary matters in the Metropolis are concerned, is also severely commented upon by the Mansion House Council on the dwellings of the poor in their first annual report,* not infrequently results in some degree of damage to the reputation of a district; but until the electors as a body can, by being taught its importance, be induced to secure the return of competent and thoroughly disinterested members, I fear matters will often be not as satisfactory as could be wished.

This should really be a feature in the education of the people. Sometimes a candidate will advocate his claim for support at a local board election on the ground that being a builder he is a "practical man," and therefore would be more eligible for the post than any one else. Another candidate asserts that his first object on election will be to oppose expenditure. I say that all these candidates deserve no support at the hands of the ratepayers. The so-called "practical man" is generally one of the most unpractical, who has some other object in view than the common interest of the district. The Sanitary Authority has, or ought to have, competent skilled advisers in the persons of the medical officers of health, the surveyor or engineer, the clerk or lawyer, and so on; and they should appeal to those officers for advice on the several matters with which they are respectively concerned, and then use their own common sense in the adoption of that advice just in the same way as any

* "Great blame for this state of things rests with the ratepayers who, mainly from sheer idleness or indifference, permit too often the election of men who have their own interests to serve rather than the welfare of the people to promote."

individual who consults his doctor, architect, or lawyer, uses his own judgment as to the adoption of the advice he receives. Again, the man who goes on a local board to oppose all expenditure clearly is unfit for the post, as he overlooks the fact that the very *raison d'être* of the Board is to perform certain duties necessary to the health and well-ordering of the district, and that the question of finance is necessarily a secondary though not much less important matter, the duty attaching to this being to secure the most complete efficiency at the least possible cost to the ratepayers.

I occasionally hear complaint that regulations commonly regarded as suitable for universal application can only be put in operation in urban districts, and that consequently certain comparatively sparsely populated places are precluded from possessing themselves of the advantages available in those respects to more populous places. I am therefore glad to avail myself of this opportunity of pointing out that by section 276 of the Public Health Act, 1875, any rural authority can, if it be desired, obtain the same powers as an urban authority to deal with nearly every matter of importance needing control in their district. In this way a rural authority can be invested with urban powers to make bye-laws on various subjects, including regulations as to new streets and buildings in their district or in any portion of it. In the year 1883 as many as 55 rural districts were thus invested with urban powers, and of these 27 obtained power to make bye-laws as to new streets and buildings.

Before leaving the question of bye-laws I may briefly refer to the subject of common lodging-houses and slaughter-houses, respecting both of which it is the duty of every sanitary authority to make bye-laws for their efficient control. The arrangement of buildings for these purposes, whether as adapted old buildings or as new buildings, involves a number of points having important sanitary bearings, but it will suffice for me here to refer to the bye-laws and memoranda which have been prepared by the Local Government Board to serve as models for the guidance of sanitary authorities when framing regulations upon those subjects. I may likewise refer in the same way to the model bye-laws and memoranda respecting the construction and management of mortuaries and cemeteries provided by sanitary authorities, both of which matters concern the sanitary engineer and architect.

Turning to the subject of water supply we find a growing demand for an unstinted water supply in our cities, towns and villages. Thus the subject of improved means of water supply in the Metropolis and in numerous large cities and towns is

receiving constant consideration, not only with reference to increased quantity, but to pure and soft quality. The careful investigation of outbreaks of disease has, during the last 15 or 20 years, largely increased our knowledge of the part which defective and deficient means of water supply plays in the cause and spread of local epidemics, and steps are now commonly taken in well administered districts to guard against the possibility of such occurrences. Notwithstanding our increased knowledge in these matters, however, we hear from time to time of serious outbreaks consequent upon neglect of the local authority to ensure the purity of the water distributed among the inhabitants, and we have accordingly seen the most disastrous results occurring. In one town of some 10,000 inhabitants, as many as 486 cases of enteric fever (of which 37 terminated fatally) occurred in a period of five months. In another town of about 8,250 inhabitants, 548 cases of enteric fever occurred (of which 42 proved fatal) in a period of six months. In a third town, having a population of some 25,000 inhabitants, an outbreak of enteric fever occurred in the latter half of the year, and during those six months over 1,200 cases were recorded, of which some 90 were fatal. In all these instances (many others could be cited) the public water supply was more or less directly connected with the distribution of the disease, and who shall estimate the whole cost, mentally as well as financially, of such occurrences to the districts concerned. In the smallest of the three towns just referred to, the keeper of the principal hotel, where I happened to find myself the solitary visitor during a stay of a few days towards the close of the outbreak, estimated that the town had lost between £50,000 and £60,000 in hard cash, while the anxiety and sorrow, not to speak of impaired health, consequent upon the illness and death of so many inhabitants was appalling. In another town an epidemic is known to have cost the rates an aggregate sum of £35,000 in money irrespective of serious loss from partial stoppage of trade. Instances of this kind cannot be too strongly impressed on the public in order to show that undue parsimony in the carrying out of whatever works are indispensable for the protection of the health of the inhabitants really defeats its object, as it inevitably leads to ultimate large expense, to say nothing of loss in other ways, instead of effecting any saving in money.

Referring to the question of water supply in rural districts, I wish to direct attention to the Public Health (Water) Act, 1878, which casts on the rural sanitary authority of a district, or on the urban authority if invested with the powers of the Act, the duty of seeing that every occupied dwelling house in

their district has, within a reasonable distance, an available supply of wholesome water, sufficient for the consumption and for use for domestic purposes of the inmates of the house; and where it appears on the report of the officers of the authority that an occupied dwelling house has not such supply within a reasonable distance, they may take proceedings to compel the owner to furnish such supply if they consider it can be done at a reasonable cost, not exceeding a certain limit laid down in the Act. This Act, which includes provisions for the protection of the individual owners and others against unreasonable demands from the sanitary authority, deserves, I think, to be more widely known than it is, for although it appears that in some cases difficulties arise in the practical application of the Act, I cannot but think it ought to be more frequently resorted to, inasmuch as at present the water supply to individual houses in rural districts is very often insufficient and almost invariably liable to contamination. It is indeed hardly sufficiently realized, I think, by the general public how commonly the village water supply is polluted. This happens from a variety of circumstances. The water is usually chiefly surface water and thus it is liable to contamination by cattle. It is also liable to pollution from farmyards, manure heaps, middens, and surface drainage generally. Another common source of contamination is the proximity of water supply to the village churchyard or burial ground. In one rural district, of which I recently had the opportunity of perusing a report by its Medical Officer of Health, it was shown that of some twenty-three burial grounds in the district, only ten could be said to present no serious sanitary objection. In one of the others, it was stated, "there are two dipping wells which are under the walls of, and at a lower level than the churchyard," and the water from these is said to be at times "extremely offensive." In another, where all the available space for burials had been used repeatedly, the drainage was said to percolate through the walls and under the floor of a number of cottages. In a third, the water supply to the village inn was said to be conveyed along a stone rubble drain passing beneath part of the churchyard, and the covering stones of this drain were frequently exposed when graves were dug.

In view of such conditions as I have just referred to, it will be admitted that the powers conferred on rural authorities by the Public Health (Water) Act, 1878, are urgently needed, and ought to be applied more generally than is at present the case.

I have a strong conviction that during wet seasons we allow much wholesome water to escape which ought to be carefully collected in suitable underground tanks for use in the following

dry seasons, and that the time will come when proper storage tanks for this purpose will be required by statute to be provided in rural localities where scarcity of water is experienced every summer. Indeed, even now, without further legislation, the provision of suitable storage tanks, such as I have just referred to, might possibly suffice to meet the requirements of the Public Health (Water) Act, 1878, where no other proper means of supply were available. The quantity of rainfall in the year varies considerably in different parts of the country. In some of the eastern districts it is as little as 20 or 25 inches, while in the west 60 to 100 inches, or more, is not uncommonly recorded. It is worth bearing in mind that if only 12 inches of rainfall over a collecting ground of one acre were to be properly stored, it would suffice to supply thirty persons with twenty-five gallons of water each per day for a whole year.

In regard to the question of sewerage, the different methods of sewage disposal, whether by ejectment into the sea, by precipitation, by surface or by sub-irrigation—the liquids in a comparatively pure state passing into the rivers and streams—all are receiving attention at the hands of sanitary engineers, and the details are being greatly improved upon year by year. In the same way the means of disposing of house refuse is receiving more attention than formerly, and there is certainly need for improvement in regard to some of the methods of dealing with the contents of dust-bins and ash-pits. I notice the increasing number of destructors that are being used for "cremating" all manner of refuse; in one instance that I know of, even the solids of the sewage of a district of some 15,000 to 20,000 inhabitants, after precipitation, are collected and mixed with the ordinary house refuse, and the whole is then passed through fire in destructors, from which the "output," in the form of clinkers, is ground up and made into concrete, paving slabs, mortar, &c. Although the various schemes for sewage and refuse disposal that have been adopted in different parts of the country, and upon different scales, have been attended with varying degrees of success, I am decidedly of opinion that the result as a whole is satisfactory, and the money expended on these works has been generally well laid out, having regard to the prime object in view, namely, the getting rid of sewage and refuse in a fairly harmless way at the least possible cost to the ratepayers.

There is another point in connexion with sewage disposal which I think calls for our special consideration. I mean the permitted construction of cesspools. Under all the modern sanitary acts cesspools are permitted to be used for the collec-

tion of sewage wherever there is no available sewer within a distance of 100 feet from the building to be drained. If the cesspool is situated in an urban district it must be so arranged and constructed as not to allow its contents to overflow, leak out, or soak away into the ground. If it is in a rural district, however, there is no such provision, and the cesspool may be so constructed that its contents may overflow into a ditch, or may soak continually into the ground. Notwithstanding the statutory prohibition* in urban districts of cesspools which allow their contents to escape into the ground, there are many towns—and, indeed, some health resorts—where this system is in full force, with populations of twenty thousand to fifty thousand inhabitants, the ground being almost completely honeycombed with such cesspools. Although such arrangements cannot but promote unwholesome conditions by certain degrees of pollution of soil and ground air, it is far less dangerous where there is a good public water-supply than where, as in many rural districts, each house draws its water from its own or from some common well. For here, even if the cesspools are required by bye-law to be made water-tight, it rarely happens that either cesspools or the drains leading to them are actually water-tight, and consequently, what with leaky drains and cesspools, the soakage from manure pits, dust-bins, pigstyes, and the like, the shallow wells in rural districts are almost always more or less contaminated. So far as cesspools are concerned, I desire to enter my protest against the system altogether, and I cannot but think that the time is not far distant when they will be universally prohibited by statute. Possibly sewage tanks of proper construction might be permissible in some conditions where they would be emptied without fail so frequently that the sewage in them would never be other than fresh, but otherwise I think the system of cesspools ought to be abolished. They are radically bad in principle and disgusting and dangerous in practice. They are bad in principle because, under the most favourable circumstances, they retain the sewage in near proximity to buildings for a considerable period, and always long after the sewage has become putrid. The walls of the cesspool once impregnated with putrid sewage will always remain so, and leaven the fresh sewage brought into the cesspool. Any more dangerous and objectionable system it is difficult to conceive, and it is probably, directly or indirectly, the cause of more injury to health than is commonly supposed. For these reasons I hope to see the system absolutely prohibited, in rural as well as in urban districts. Indeed,

* Section 47 (3) of the Public Health Act, 1875.

I think there would be little real difficulty in prohibiting cesspools altogether in the case of new buildings. Where a house or an institution has to be built, there ought to be proper sewers, or some other suitable and proper means of getting rid of the sewage while it is still in a fresh and comparatively harmless state. If the local conditions would not permit this, I think the erection, or at any rate the occupation, of the building should be deferred until proper arrangements could be made. This would surely be better than either that the soil and ground water should be poisoned by the constant discharge into it of foul sewage, or that the sewage should be collected and retained in close proximity to the building until its removal is inevitably attended with danger as well as with nuisance. The use of cesspools is, I venture to think, continued to a great extent merely from force of habit. People have been so accustomed to regard the provision of cesspools as a necessity that it is assumed as a matter of course that they are indispensable. This is, however, by no means the case, and in support of my contention I would refer to what has taken place in regard to the use of middens in many of the large towns of Lancashire, Yorkshire, and elsewhere. It was formerly the custom in those towns to construct huge midden pits that were emptied only when full, at intervals of many years, and it was alleged that these were indispensable. But in the best-administered towns where this was the case, such middens have been abolished, and indeed are now prohibited, while small receptacles, wholly above ground, and from which the filth is frequently removed, and always before putrefaction has set in, are now invariably adopted. I venture to hope the same action may be taken with regard to cesspools.

We have heard a great deal during the last few years about the dwellings of the poor, and quite recently we have had the advantage of considering the reports of the Royal Commission on the Housing of the Working Classes. It is, however, often forgotten that the subject is an old one. Shortly after the first constitution of the Poor Law Commission, about 1835, the condition of the labouring classes attracted attention, and in 1839 the Poor Law Commissioners were directed by the Queen to make an inquiry on the subject, and in 1842 the results of that inquiry were framed by the secretary of the commission, Mr. Edwin Chadwick, in a report which, to this day, is regarded as quite a standard work on the subject. The author of that report, I am pleased to say, is still among us, and actively works to promote the sanitary welfare of all classes. The name of Edwin Chadwick, C.B., will ever be honourably associated with

the subject of sanitary engineering and architecture. That report also contains a plan suggested by Mr. Sydney Smirke, the eminent architect of that day, for a so-called "public lodging house," containing in three storeys some 50 or 60 separate single-room tenements. Shortly afterwards societies were formed for the purpose of improving the condition of the dwellings of the labouring classes, and one of these societies, under the presidency of the late Prince Consort, exhibited at the Great Exhibition of 1851, a block of model houses. Other societies, having similar objects, became established in the provinces, and various model villages were formed, as at Saltaire, near Bradford, Ackroydon, near Halifax, &c. Still later we have the effects in the Metropolis of Sir Sydney Waterlow's Society, and the trustees of the Peabody Bequest, besides numerous other societies which have produced numbers of small houses, such as those of the Queen's Park and Shaftesbury Park Estates in London, and others elsewhere.

There is thus evidence of much useful work having been done in the way of providing improved dwellings for the people, and some idea of the extent of it may be inferred from the fact that in London alone no less than twelve millions of money is said to have been invested in buildings containing separate tenements for the accommodation of the working classes. But notwithstanding all that has been done in this direction in the last fifteen or twenty years, the problem seems still as difficult as ever, and, according to evidence taken by the Royal Commission, the condition of the working classes is still, in many places, more or less a scandal to the times. The normal death rate of London as a whole is about 21 per 1000, and when we read that in some parts of the Metropolis the death rate is stated to have reached, in 1882, 44 and 53·7 per 1000, while the rate, calculated for a small number of houses in one particular part, reached 70 per 1000, or two or three times as great as the average, and in certain parts of some of the large provincial towns the rate is still said to be "very high," the necessity for agitation, in order to remedy this state of things, is at once apparent. There appears in this, as in other matters demanding attention, to be a vast quantity of remedial power available, but a lack of readiness on the part of those in local authority to apply that power. Here, again, we come to the necessity, as it seems to me, for stirring the public to demand that those elected to positions of responsibility in the matter, should use the powers vested in them for dealing with these important subjects. Important they certainly are, for the results of neglect to use the existing powers already possessed, have led to such serious overcrowding

as to affect the health and working power of the inhabitants in a manner that altogether fails to be illustrated in the death rate returns, even high as they are. The children are permanently injured by it, and the adults are likewise injuriously affected by it in health as well as in means; for it has been found on inquiry that, on the lowest average, every workman or workwoman in certain overcrowded localities, loses about twenty days in the year, not from illness, but from sheer exhaustion and inability to do work; and this at a very moderate wage per diem would amount in the aggregate to a not inconsiderable sum in the year. Overcrowding in a house is, by statute, a nuisance which can be dealt with by law. Local authorities, moreover, have, or can have, full power to control the number of persons, not members of one family, who may occupy a house or part of a house which is let out in lodgings; they can also have such houses registered, inspected, and put into and kept in proper sanitary condition. But hitherto very few authorities have assumed these powers, while many that have been invested with them, have entirely failed to enforce them. The provisions of the Artizans' Dwellings Acts of 1868 and 1882 (Torrens), and of the Artizans' and Labourers' Dwellings Improvements Acts of 1875 and 1882 (Cross' Acts), and the Labouring Classes Lodging Houses Acts of 1851, 1866, and 1867, contain very extensive and useful powers for dealing with the subject where desired by the local authority. Local authorities throughout the Kingdom have been reminded of these powers, and useful digests of the Acts have been sent to them, and still all the evils—moral and sanitary—of overcrowding continue. Let us hope that one of the useful results of this Congress will be to help to stir up the public to demand energetic action of sanitary authorities to use the powers they already possess, and thus diminish the scandalous conditions which have been recently referred to in the Report of the Royal Commission on the Housing of the Working Classes.

With regard to the blocks of artizans' dwellings and model lodging houses which have sprung up in various parts of the Metropolis and in some of our more populous provincial towns, all will agree that the clearing of crowded areas covered with the worst forms of dwelling-house is in itself a most excellent move; but I look with grave apprehension upon the vast piles of buildings that are often erected with the avowed object of affording accommodation for the people who have been displaced, but which actually get occupied by a different and higher class occupier, thereby tending to aggravate the overcrowding already existing in neighbouring districts. One sees huge blocks—five, six, or seven stories high—sometimes

connected with each other and sometimes detached but in such close proximity to one another that the sun can never reach parts of the internal open spaces, and so that the air in those spaces must be more or less stagnant. Some of these buildings contain hundreds of separate dwellings, each dwelling holding on an average four or five persons. Such buildings, I maintain, are unworthy of their prime object. They may deceive their promoters at first by appearing fairly wholesome and, in comparison with the houses and tenements previously occupied, as being an improvement; but I fear that after the lapse of some years they will become unwholesome and be regarded with diminished satisfaction, while their death-rate, which in their early years is generally low, will increase. Indeed, in some of the blocks that have been erected in London, there are not wanting indications that, from some cause not at present definitely explained, the infant death-rate has been excessive, and even greater in the block of dwellings than in the surrounding unreformed neighbourhood.

I am confident that the massing together of vast numbers of human beings in dwellings of great height and capacity—rooms piled one upon another to a height of 60 or 80 feet or more—is not a proper system. We cannot with impunity crowd an unlimited number of human beings on a given area. This has been decided with respect to the sick, and is equally evident with respect to children, and similar conditions will, I believe, come to be recognized with respect to people of ordinary health and habits. There are doubtless degrees of relative proportion of people to area according to their condition, and to a certain extent according to the character of the building and its surroundings, but hitherto we have not arrived, so far as I am aware, at the precise limits of proportion of ordinary population to area. The subject is one which deserves careful attention, and indeed has not been altogether overlooked by some of those concerned with the more recently designed blocks of dwellings in London. The danger of piling up these dwellings in buildings of great height has received illustration in the older parts of Edinburgh, where the houses, as you are aware, reach eight or nine storeys in height, and have no internal connection with drains; the refuse is removed in tubs daily, and there is an excellent water supply. I am assured on high medical authority that notwithstanding these arrangements, the first cases of typhus almost invariably occur in the upper storeys.

It has been my good fortune to have opportunities of noticing the arrangement of various institutions having for their object the housing of large numbers of persons, old and young, both in health and in sickness of body and mind. I look back at

many old buildings, whether hospitals, asylums, workhouses, schools, or the like, and find enormous blocks containing wards ranged along both sides of dark passages, and holding vast numbers of human beings under one roof in practically one atmosphere. That arrangement of building may now be regarded as wholly obsolete, and as having given place to what is known as the pavilion system, under which the building is sub-divided into a number of separate blocks or pavilions, each containing a comparatively small number of inmates, and affording far greater facilities for effectual ventilation of the apartments, as well as for the access of light and circulation of air about the pavilions. This system in one form or another, is now, in principle at any rate, invariably adopted for all well-arranged institutions intended for large numbers of persons, but in many instances I have noticed that the advantages of the separate pavilion system are completely counteracted by the way in which the several pavilions are joined together, solely for administrative reasons, by enclosed corridors in basement, ground, and one-pair storeys, and thus, by means of lifts for coals, lifts for inmates, shoots for dust and for soiled linen, staircase well-holes and the like, the several blocks or pavilions have been most successfully transformed into one uniform building, having one and the same atmosphere throughout every part of it. The objections to these arrangements, by which the prime object of the pavilion system is defeated, are perhaps more conspicuous when adopted in buildings occupied by a number of sick persons or by children, than in any other class of building, and I am under the impression that in England, while we aim with much success at perfection in detail arrangements, we are considerably inferior in many of the broad principles of arrangement to some of our continental neighbours. The hospitals erected in the last eight or ten years in some of the continental cities and towns are specially worthy of attention in these respects. Spread over large areas of ground—in some instances perhaps needlessly large—the wards being only one storey high, absolutely detached one from another or having only a covered way between them, and being limited in size to the requirements of some 14 to 20 beds each, being raised on arches well above the ground, and arranged so that the patients while still in bed may be wheeled into outside balconies, so as to have the advantage of treatment in unenclosed air. Such hospitals, and they have been fully described in recent works on the subject, seem to me to approach very nearly perfection of arrangement, and to afford examples such as it is difficult to find at home. In respect of children's buildings, again, the dangers of concentrating large numbers of children in dormitories, or indeed in any confined space, have

long ago been demonstrated as tending to impair the health and to aggravate any tendency to disease. There is no necessity for placing many children in dormitories, and the massing together of large numbers in school and class rooms is only tolerated by reason of the comparatively short time those rooms are occupied. And even here it would be a boon, having regard to the small amount of space usually allowed to each child, if the school and class rooms could be completely vacated, as recommended by Mr. C. E. Paget,* for ten minutes or so every hour, so that, by means of open windows, they could be completely flushed out with fresh air at frequent intervals. The system of arranging domiciliary schools upon what is known as the cottage-home principle, has so many advantages, sanitary and otherwise, that it deserves attention by all who are concerned in the welfare of the young. It has been adopted in recent years for many charitable and poor law institutions, and I have invariably heard it spoken of most favourably. The schools of the Leicester Poor Law Union, which are at Countesthorpe, are upon this system, and will well repay a visit.

You will perceive that I have taken an encouraging view of the present condition, and a hopeful view of the future of sanitary engineering and architecture. In saying this, however, I would not have it supposed that what has already been achieved should be regarded as adequate under every head. There is still a great deal to be done, and perhaps the most useful way of furthering this is by educating the people to appreciate all that tends to healthiness of body and mind. By doing this the public may be led to demand that more use shall be made of the powers already in existence. One hears occasionally a desire for more legislation, but it has been shown conclusively that there are already many valuable powers relating to health matters that are allowed to remain a dead letter, owing, not so much to any ignorance of the existence of these powers as to the apathy of the authority immediately responsible for putting them in force, and, as the late Royal Commission observe in regard to the making of certain bye-laws, no action will probably be taken "until the people show a more active interest in the management of their local affairs." The creation and the increase of this interest I regard as one of the chief aims of this Congress. These annual gatherings in different parts of the kingdom must not only be utilised for keeping alive the interest in sanitary matters which has so far been awakened in the

* Health Exhibition Literature, Vol. I., page 378.

public, but each year's Congress must give fresh impetus to the work, and so keep it actively progressing during the ensuing twelvemonths. Former Congresses have done good work in this direction, and the present one promises to be no less successful; but in order to insure its complete success, as well as that of the Sanitary Institute, we must one and all—individually and collectively—use our utmost efforts to gain the confidence of the public and to carry them with us.

Prof. F. S. B. F. DE CHAUMONT, M.D., F.R.S. (Southampton), moved a vote of thanks to the President of the Section for his address.

Mr. ROGERS FIELD, M.INST.C.E. (London), in seconding the motion, remarked that Mr. Gordon Smith had modestly refrained from mentioning several facts that ought in justice to have been mentioned. The model bye-laws to which allusion had been made were among the most important things that had ever been done by the Local Government Board. Those bye-laws very greatly tended to advance sanitary improvements generally and to improve the health of the community. Mr. Gordon Smith, as Architect to the Local Government Board, had a very large share in drawing them up, and the public was very greatly indebted to him. As to the question of cesspools, he entirely agreed with the President that they were radically bad in principle, and disgusting and dangerous in practice; and he thought that it was an exceedingly fortunate circumstance, for the progress of sanitary practice, that the chief architect to the Local Government Board should have expressed the strong opinion on the subject which he had done.

Mr. P. GORDON SMITH briefly acknowledged the vote.

On "The History of Sewerage and Sewage Treatment at Leicester," by JOHN UNDERWOOD.

At the time of the passing of the Public Health Act in 1848, Leicester was, in common with many other large towns, in a condition much needing sanitary improvement.

In 1846 a local Act had been obtained by the corporation

entitled "An Act for Improving the Borough of Leicester," but the powers conferred by that Act were found to be quite inadequate as related to the more important measures necessary for improving the sanitary state of the town.

"The Public Health Supplemental Act, 1849," which constituted the town council the local board of health, received the Royal assent, and came into operation on the 1st August, 1849. In the same year a preliminary enquiry was held at Leicester under the Public Health Act by William Ranger, Esq., C.E., superintending inspector of the General Board of Health, and a report founded on that inquiry was made to the board on the "Sewerage, Drainage, Supply of Water, and the Sanitary Condition of the Inhabitants of the Town of Leicester." In this report the intrinsic difficulties of the question were recognized. The town itself was described as in the main situated on a saucer of loam, the brim of the saucer being formed by a range of shelving hillocks broken to the east only, in which quarter the town was much exposed, and from which it principally derived its ventilation, being thus unfavourably situated. The peculiar course of the river to the west of the town was also remarked upon, its high level compared with the land adjacent, and the aspect it assumed of a series of stagnant pools in dry seasons, being held up by mills and locks, and with scarcely any flow. The sanitary state of the town was found to be very bad, fever was rife, and of a fatal character, and not confined to the lower parts of the town, but extended to the higher. The most palpable source of the fever was said to be the miasma arising from the evaporation of the foul water, which inundated certain parts of the town during the summer floods, and by which the impurities from the larger sewers were carried back into many of the houses, yards, and streets.

Mr. Flint, an eminent local architect, said: "At the back of the various blocks of houses there is in almost all cases a common yard, whose surface, from the retentive nature of the subsoil (and where it is of a different character it is thoroughly inoculated with the liquid refuse and effluvium from privy pits and rainwater), offers an extensive area for the exhalation of noxious effluvia, and in other parts where the property abuts on the streets, and in large portions of the unoccupied land, as well as parts of yards to the houses which are enclosed by the embankments of streets and by adjoining higher ground basins are formed into which the rain is received and stagnates. From these basins there is no efficient or regular drainage, and the water can only pass away by the slow process of percolation and evaporation."

Dr. Shaw reported: "I have been shocked on entering some of the confined courts and alleys to find the inhabitants living amidst masses of decomposing animal and vegetable materials, totally unconscious of their danger, and even speculating on their heaps of infection, and amassing with anxiety the filth deposited in the neighbouring streets."

Mr. Stallard, in speaking of the physical condition of the poor, said: "I believe it to be gradually deteriorating."

In reference to the streets, Mr. Flint said: "Although the streets are generally paved, there is a total absence of proper inclinations for conducting the surface water off, consequently, water hangs upon the surface, and with it every kind of filth, including blood and offal from slaughter houses, which is swilled down on the surface in front of the dwellings, and in one instance to the extent of about a quarter of a mile."

The population of the town was slightly over 50,000. The number of streets was given as 242; of these only 112 were culverted, and no less than 130 either not culverted, or but partially so. There were no regulations for draining the streets or courts, and what had been done was the result of arrangements at different times among the owners themselves. The culverts were originally intended for the conveyance of surface waters, and mostly took the place of the old open ditches or water courses; by degrees the owners had been allowed to connect house drains with them, and they became the receptacle for every kind of filth, conveying it to their natural outfall the river Soar, which was thus constituted virtually the main sewer of the town.

This was the state of things when, on the 5th September, 1849, the highway and sewerage committee of the Corporation, realising their responsibility as the local board of health, passed unanimously the following resolution: "That Thomas Wicksteed, Esq., of London, should be appointed engineer, for the purpose of reporting as to the best mode of draining and sewering the borough, and of presenting a plan with an estimate of the expense."

Mr. Wicksteed was said to be personally unknown to every member of the Board, and to have been selected solely on account of his high professional reputation, and the admirable evidence given by him as published in the first report of the commissioners for "inquiring into the sanitary state of large towns and populous districts." The result was, that Mr. Wicksteed accepted the appointment, visited Leicester, and made a survey of the town and neighbourhood, and on the 12th March, 1850, presented a "preliminary report," which was ordered by the committee to be printed, and it was largely circulated.

In the introduction to this report, an interesting summary is given of the principal objects which Mr. Wicksteed and the committee considered were to be attained:

"1st. The diversion of *all* sewage, dye, and scouring waters from the river Soar and the Leicester Canal, and their removal, as speedily as possible, from *under* and near the town of Leicester, so as to relieve the town from noxious exhalations, and to restore the river to the salubrious state in which it was before it was made the common sewer of the town.

"2nd. The removal of this sewage to such a point in the river *below*, that the process of collecting and disinfecting may be carried on without injury or annoyance either to the inhabitants of the town itself or to those of the adjacent villages; and that the process to be adopted in its disinfection be such that the water, before it is returned into the river Soar (*below* the town), shall be in a state of at least as great purity as it was in the river *above* the town, before any sewage or dye waters had contaminated it.

"3rd. That the level of the sewers shall be at such a depth that the lowest parts of the town shall at all times be capable of being well and thoroughly drained.

"4th. That the fall in each sewer shall be sufficiently great to produce a velocity that will not only carry off rapidly the liquid filth poured into it (so as not to allow of stagnation or of time for decomposition), but also to produce a sufficient scouring power to prevent the accumulation of *débris*, or heavy deposits of road drift.

"5th. That there shall be a daily and *nightly* supply of water, abundant in quantity, for cleansing the sewers, and neutralising any bad odours remaining therein, after the bulk of the daily sewage shall have ceased to flow.

"I am also of opinion that no scheme for the sewerage of a town can at the present time be considered complete unless it embraces the means for converting the sewage water to useful and profitable purposes, so as to *reduce*, as much as possible, the expenses of sanitary improvement, if not to merge them altogether in the receipts arising from the sale of the *manure*."

This report was termed a "Preliminary Report," because it left open for further consideration the exact position of the outfall of the sewage, and also the detailed plans and estimates. A further written report was made to the committee by Mr. Wicksteed, on the 14th July, 1851, followed by plans, specifications and estimates. An Act of Parliament was applied for and obtained in the Session of 1851 for enabling the corporation to carry out the scheme as recommended by Mr. Wicksteed and the General Board of health was memorialised for sanction

to the borrowing on mortgage of the rates for the execution of the works.

Mr. Lee, Superintending Inspector, visited Leicester, and reported to the general board; and his report may be described as an adverse detailed criticism of Mr. Wicksteed's scheme as a whole. The following remarks as a "recapitulation" at the conclusion of his report, will give an idea of the Inspector's views:—"I think it has been shown that there is no proper survey upon which alone any efficient and economical system of drainage of the town can be devised; that even for purposes of main sewerage the scheme before you is very incomplete; that the proposed main sewers in the town are neither fit for the sewage alone, nor for the rain water, nor for the two combined; and that they would be unnecessarily expensive, even if unobjectionable, on other and strictly sanitary grounds of consideration.

"That every slight shower, even if the sixty-sixth part of an inch in an hour, would cause more than half-a-million of gallons of sewage to be impounded in the main sewers under the town, displacing and driving back into the dwellings the same quantity of noxious sewer gases. That a great part of the town, at least, might have been drained by gravitation.

"That the reservoirs, and the drying process together, will convert on the average 5,395 gallons of sewage daily into vapour, contaminating the air. That Mr. Wicksteed has misquoted, and misstated the report of the chemists, and neither can nor does propose to use the same re-agent for disinfection as was used in all their experiments; and that, notwithstanding the use of lime water by them, in the proportion of one-third the volume of sewage, the fluid remained offensive.

"That the whole of the works connected with the engines and reservoirs, and the so-called process of disinfection, would be enormously expensive, and would inflict incalculable evil upon the health of the inhabitants of the town.

"That it is very doubtful if the lime-water, or lime-process would pay its own expenses, even as against spontaneous subsidence in these immense reservoirs, irrespective of any sanitary considerations. The following were Mr. Lee's "Conclusions":

"For the reasons above-named, and fully discussed in the body of this report, I cannot advise your honourable board to sanction the mortgage of the public rates of the borough of Leicester for the execution of this scheme; and I recommend that, for the protection of the Local Board and the preservation of the health and lives of the inhabitants, you should altogether refuse such sanction."

The general board forthwith, in a letter to the local board,

expressed their regret that they were compelled to withhold their sanction to mortgage the rates for carrying out the proposed plan of drainage, for the following reasons:—

"1st. Because it is incomplete, and, having been prepared on insufficient plans and information, not only is there no security afforded that the partial lines of drainage are the most judicious, but there is, on the contrary, abundant evidence to prove that their direction is not well selected, and that they would be inefficient and unnecessarily costly.

"2nd. Because instead of leading the whole refuse of the town into sewers at the lowest levels, merely to be pumped up again, the larger proportion might be conveyed so as to discharge by gravitation; thus not only effecting a saving in the dimensions of the work, but avoiding a perpetual tax upon the rate-payers for unnecessary engine power.

"3rd. Because even if the sewers were properly laid out, they are neither properly graduated nor properly adjusted to the work which they would have to perform.

"4th. Because the proposed mode of dealing with the refuse would be attended with the utmost risk to the health of the population, and would be of very questionable expediency in a financial point of view. It would commit the local board to a vast speculation, which the most favourable results of chemical experiments in no way justify, and which in case of failure would entail a most serious lasting tax upon the inhabitants.

"5th. Because of the £35,000 for which application for a mortgage is made, no explanation is afforded; nor does any estimate appear to have been prepared with regard to £5,000; and because the whole of the partial works proposed might be much more efficiently carried out, and the beneficial results more certainly attained, at a very considerable saving in their estimated cost of *thirty thousand pounds.*"

The local board was, therefore, in a dilemma, the council having obtained Parliamentary powers to carry out the scheme; they were refused authority to borrow for the execution of it, and in reference to this refusal in their report on March 17th, 1852, they said:—"The committee deeply regret the obstruction which has thus unexpectedly arisen to the immediate progress of sanitary improvement, as they are fully satisfied that there is a great amount of preventible disease in the borough, which would be remedied to an appreciable extent by an improved system of sewerage, and that the mortality, which in some of the undrained parts is no less than five per cent. per annum, might have been very materially reduced."

The report of the inspector of the general board was sent to Mr. Wicksteed, in order that he might have an opportunity of

explaining and defending his scheme, and answering the objections of Mr. Lee. This Mr. Wicksteed did, in a very able reply, which was presented to the council simultaneously with the inspector's report to the local board, and after consideration it was decided by the local board to wait by deputation upon the General Board in London; which they did with the proposition that the plan and reports should be submitted to either Mr. Robert Stephenson or Mr. Rendel for opinion and advice. Lord John Manners, on behalf of the General Board, thought the proposition not at all unreasonable, and said the Board would therefore wish that the matter should be submitted to Mr. Stephenson, and that his opinion and recommendation would be received with the greatest respect and attention, and have due weight with the Board, but that as a public board they could not of course give any pledge.

A report from Mr. Robert Stephenson was therefore obtained, and it was, on the whole, decidedly favourable to Mr. Wicksteed's scheme. One or two paragraphs in Mr. Stephenson's report may be quoted, as they refer to points which are at present matters of interest and discussion in the town:—

"1st. With reference to the drainage of the *higher district*, as suggested by the inspector, I think it may be effected through an intercepting drain without pumping, although misgivings have, I understand, been entertained about it; but there can be no doubt that a separate system for this particular district will add to expense without increasing efficiency.

"2nd. The low level of Leicester generally with reference to the Soar, into which the drainage must eventually flow, and the very little fall in that river, make the sewerage of the town of considerable difficulty, and not to be accomplished without pumping as proposed. The outfall might be carried lower down below the Belgrave mill tail, but at an increased expense of construction, and the same expense of pumping, the fall of the valley being no more than is necessary for giving the required velocity through a prolonged sewer, the only advantage from which would be, that any exhalation would be further removed. If the chemists be correct, there is no danger to be apprehended in the site of the reservoir now intended, and in this opinion my experience leads me to concur."

On consideration of Mr. Stephenson's report, the general Board waived their objections, and consented to the carrying out of Mr. Wicksteed's scheme. Several modifications in detail were adopted; the outfall was removed to the western side of the river, the size of the depositing reservoirs which had been contemplated in the "preliminary report" as of 3½ acres in extent and situated in the Abbey Meadow, was abandoned in

favour of smaller and covered tanks on the site of the present works, and as now in existence. But the sewers were carried out mainly as designed, but were in some cases reduced in size as the distance from the works increased, and they may be briefly thus described:—The sewer in Abbey Meadow, 4ft. 8in. in diameter; (1) West main sewer, 39in. diameter; (2) East main sewer, 27in. diameter; (3) Central main sewer, 27in. diameter, and other sewers varying in size according to circumstances, the whole length about 40 miles, the depth varying, but generally speaking about 12 feet below the surface, excepting the foregoing main sewers, which were deeper than 12ft. Estimated cost—£55,000.

In connection with the scheme for sewering the town, of course it was necessary that the question of sewage treatment should be considered, and Mr. Wicksteed appears to have given great attention to it. The successful application of sewage in its liquid state to land at Edinburgh, had been commonly referred to. The rare combination of circumstances there existing were admitted, but it was still held as a primary condition that, whatever system was adopted, the operation must "be useful and commercially profitable."

Mr. Wicksteed accepted with great enthusiasm this condition, and with energy set himself to prove its truth. As to the application of sewage to land, Mr. Wicksteed satisfied himself that, although there might be localities favourable for a limited adoption of such a plan, nevertheless, to provide for the distribution of the whole of the sewage water of a large town by such measures would, in his opinion, be a most "imprudent speculation." He discussed its distribution by pipes analogous to a water supply, and concluded with the remark:—

"I think it will appear very evident that the distribution of the *whole* of the sewage water could never be *profitably effected* by such means. At the same time it is but right to observe, that the distribution of a *portion* of it over the Abbey Meadow, and the lands in the immediate neighbourhood, would not involve so great an expense, and in a commercial point of view this might be worthy of consideration, were there no objection on the score of *health*."

The reports of the eminent chemists, Messrs. Aikin and Taylor, Professors of Chemistry in Guy's Hospital, appeared to prove conclusively that the application of lime would do all that was necessary to purify the sewage, and would leave a deposit which, if quickly dried, would be a cheap and useful manure in a concentrated form, and which might be readily packed for disposal similarly to guano.

Mr. Wicksteed had long leaned to the side of the chemists,

and a solid manure scheme as against a liquid manure scheme, and during his preparation for Leicester sewerage he had also actively pursued his investigations in this direction, and had become fully convinced that a solid manure of great value could be obtained. So satisfied was Mr. Wicksteed that his conclusions were sound, that he foreshadowed in his report that "he had but little doubt that responsible parties might be found who would supply the necessary capital for constructing the works for the manufacture and sale of the manure, and deliver up the said works to the town council in a state of good repair and good working order at the expiration of 30 years from their establishment."

Imbued with these ideas, and having received encouragement in various directions, Mr. Wicksteed himself, in 1851, took out a patent for the manufacture of sewage manure, one of the principal features of the process being the application of centrifugal force for the separation of the water from the deposit in the bottom of the reservoirs. In the following year an Act of Parliament was obtained, incorporating the "Patent Solid Sewage Manure Company," and enabling the company to raise capital to the extent of £100,000.

In a report to the Metropolitan Commission of Sewers in 1854, Mr. Wicksteed referred at length to the operations of The Patent Manure Company in their purification of the sewage and manufacture of solid manure at Leicester, and, at the risk of making rather a long extract, I think it will be best to take Mr. Wicksteed's own description of his processes, which was written at a time when he was anticipating their complete success, and these temporary works were adopted as a model for all further operations. The reference is as follows:—

"In February, 1852, the directors resolved that temporary works should be erected in Leicester for the purpose of manufacturing the manure upon a sufficiently large and practical scale, having in view three objects: the first being to ascertain whether the lime process effectually disinfected the sewer-water, and if so, whether it could be practically used upon the large scale; the second to ascertain whether the removal of the precipitate from the bottom of the reservoir, and the abstraction of the water from it by means of centrifugal force, could be practically carried out upon the large scale and at a sufficiently small cost; the third object being to manufacture a sufficient quantity of the manure to enable agriculturists to prove its commercial value, considering that their practical opinions would be a much better test than chemical analyses only, and it was resolved that upon the result of these trials the question of proceeding with the company should be decided. Works were accordingly

erected, and after many alterations and improvements upon the original scheme, which probably would not have suggested themselves unless the opportunity of carrying the plan out practically had been afforded, the directors were so satisfied with the result, that they felt justified in entering into a contract with the town council of Leicester, undertaking in return for the exclusive right to all the sewage water for a period of thirty years, to disinfect it, and discharge the water in an innoxious state into the river Soar for the same period.

"I will now proceed to describe the temporary works and the process, to the maturing of which I have devoted the greatest portion of my time for the last two years, and have completely satisfied myself that the scheme is not only practicable and remunerative, but may be made very profitable when carried out on a larger scale than opportunity has hitherto afforded.

"The temporary works at Leicester were erected upon ground belonging to the town council, upon the banks of the Leicester navigation, near the outfall of the filthiest sewer in the town, a branch from which supplied the works with sewer water. The use of the ground was granted to the company at a merely nominal rate by the town council, who in this, as in other instances, have afforded every facility to enable the company to demonstrate to the public the practicability of disinfecting the water and manufacturing the manure.

"As regards the size of the temporary works, they were calculated for a population of 5,000, previous to the introduction of a supply of water into the town from the new water works. I do not mean to imply that we have actually deodorized the sewer water from a population of 5,000 during twelve months, for this would be inaccurate, as the constant interruption arising from the practical modifications and improvements of the machinery used in the process would of itself have prevented such a course; but the works have, for different periods, been kept in continuous operation day and night, that I might have the opportunity of assuring myself that the process was complete as affecting the sewer water during any of those periods, the object of these temporary works being, as I have before stated, to ascertain whether the process could be practically and remuneratively carried out by the means proposed.

"At the commencement of our operations, it was found that the process of deodorizing was not perfect, and it was discovered that its partial failure was due to the sewage water being in too concentrated a condition, the new supply of water to the town having only been introduced at Christmas last, while the operations of the company commenced more than a year and a half ago. To prove whether this conjecture

was correct, a portion of the partially deodorized water was returned into the engine well, and when the concentrated sewage was reduced to a quality equal in strength to that of the Metropolitan sewer water, the process was completely successful.

"Professors Aikin and Taylor ascertained the strength of the London sewer water, and determined what amount of dilution was necessary to reduce the Leicester sewer water to the requisite strength, and by their experiments I was guided in my practical operations.

"Again, it was found that at night, when the manufactories were not at work, and the waste water from the engines had ceased to flow into the sewer, their contents being chiefly urine and excrementitious matter in a state of far greater concentration than the day sewage, the effect of the lime was only partial; but upon diluting it as in the former case, the process of deodorizing was completely successful—the effluent water from the reservoir after the process was completed being perfectly free from all taste and odour, excepting occasionally from the lime when it had been used in excess.

"A quantity of the effluent water from the reservoir was taken in August last by Mr. Theodore West, chemist, of Leeds, and subjected to an analysis; and he found that there was not a trace of any other matter than carbonate of lime, sulphate of lime, and chloride of sodium; proving clearly that all noxious matter had been abstracted during the process.

"The mode of operation in this process is as follows:—the water is pumped up from the sewer, and into the pipe conveying it to the reservoir a smaller pipe is introduced connected with the lime pump, which works stroke for stroke with the sewer water pump, and the process of deodorizing is so rapid, that when the mixture of sewer water and lime is discharged into the reservoir, there is no noxious odour arising from it; the discharge takes place into the first part of the reservoir divided into three compartments, in each of which is an agitator worked by the engine; a thorough mixture having thus been effected, it flows through the upper end of the reservoir, and is from thirty to forty minutes passing through this portion, during which time seven-eighths or more of the separated matter has been precipitated on the bottom of the reservoir. There still remains, however, about one-eighth of solid matter, which, being lighter than the first portion, requires a longer time for precipitation, so as to render the water clear and bright.

"The water is, in fact, two hours in passing from the sewer to the farthest end of the reservoir, where it is discharged, and arrangements are made to enable the water to flow con-

tinuously through the reservoir, with as nearly as practicable the same velocity over the whole section, the openings of the discharging gates being proportioned to the depth of water in the cross section, and thus the necessity of having two reservoirs, for the purpose of filling one while the water in the other is being cleared by deposition is avoided, for although the stream is continuous, its velocity being only about one-fourth of an inch per second, it does not interfere with, or arrest, the precipitation of the solid matter.

"The operation of moving the precipitate from the bottom of the reservoir, so as not to interfere with the continuous flow of the water in the reservoir, is performed by means of a screw, which removes the precipitated matter into an adjoining well or shaft as rapidly as it is formed, without disturbing the process of precipitation which is carried on above it.

"The bottom of the first portion of the reservoir is made to slope towards the centre, along which a culvert runs, semicircular at bottom and open at top; in the bottom of this the screw is laid, and the precipitate collecting upon it from the sloping slides, is, as the screw revolves, carried into the adjoining well; the practical working of this arrangement is now completely successful.

"It is the combination of these two arrangements, viz:—the continuous current and the removal of the deposit without disturbing the supernatent water—that has enabled me to reduce the size of the reservoirs to so great an extent; this will be seen hereinafter, when I give the sizes of the reservoirs I propose for the Metropolis.

"The next operation is to raise the deposit or mud from the well or shaft, by means of a Jacob's ladder, very similar in appearance and construction to the ladder of buckets in the dredging machines used on the Thames, excepting that its position is vertical and its construction much slighter; the mud thus raised in a semi-fluid state into a tank, flows through a pipe to the centrifugal machine, the machine is then set in motion at the rate of about 1,000 revolutions per minute, and in half-an-hour from the time the precipitate was laying on the bottom of the reservoir, it is in a sufficiently dry state to pack in casks, or to mould in the form of bricks for farther drying.

"A given bulk of the manure, when introduced into the centrifugal machine, is reduced to about one-third of its original bulk, two-thirds, as water, having been separated from it by the operation.

"The machines which are now making for the new Leicester sewage works, are each calculated to turn out 360lbs. of manure in an hour in the state of consistency previously mentioned.

"Thus it will be seen that the whole operation of disinfection and conversion into manure is very simple, and I think it must appear evident after the experience of a year and a half of what may be done in works sufficient for a population of 5,000, that by simple multiplication of the means, it may be made available for any population, however great; as in this case the increased quantity of sewage water merely involves a simple increase of machinery in proportion to this increase, the increase of power for raising it being in direct proportion to the quantity.

"As regards, however, the proposed large works for Leicester, there will be two reservoirs, about 200 feet long and 44 feet wide, two-thirds of the area will be covered with an iron girder and brick arch floor for the warehouses above, to economise space, and the whole will be roofed over; and as this portion of the design is intended to be carried out in all future works, however large, all chance of nuisance from exposure is avoided; but the fact is completely established, that no nuisance does arise either from the reservoirs or in the process used in manufacturing.

"Although not in a position at present to state what the 'actual commercial value of the residual manure' will be, because, as before intimated, the desire of the directors of the Patent Solid Sewage Manure Company has been to leave this to be determined by the result of its practical application by the agriculturist, and at present the manure that has been so applied has been *pro tanto* inferior to what is intended to be supplied, in its having been chiefly collected from the day sewage unmixed with the richer night sewage, and also from the fact of its containing 60 or 70 per cent. of water instead of 20 per cent., which is the quantity it would have contained if the extent of our temporary works had afforded us room for drying it in larger quantities than has hitherto been practicable; nevertheless, our experience has been quite sufficient to prove that without the necessity of having recourse to expensive applications of artificial heat, simple exposure to atmospheric influence for a few weeks will reduce the moisture to 20 per cent., so that bulk for bulk the manure intended for sale will contain twice as much fertilising matter as that which has at present been forwarded to agriculturists for trial. The present results, however, show that, taking guano at £10 per ton, the manure as proposed for sale is at least worth £2 13s. per ton; but as I stated to the commissioners verbally, I have considered it safest to calculate its commercial value at £2 or £2 2s. per ton, and this amount would yield, after deducting the cost of manufacture and repairs, a fair percentage upon the capital expended in the construction of the works.

In discussing the financial aspects of the case in relation to the sewers and water supply for Leicester, Mr. Wicksteed stated his anticipations as follows:—"The quantity of manure that will be collected in the bottom of the depositing reservoirs will be equal to at least 10,000 tons per annum in the first fifteen years, and 20,000 tons per annum in the second like period. This, when fit for removal, will contain 33 per cent. of water, and supposing it, when high dried, to be worth £2 per ton, in the damp state it will be worth 27s. per ton, and thus deducting 7s. for expenses, will leave 20s. as the net produce per ton.

"If, therefore, a market can be found for the sale of the quantity manufactured (of which there is probably but little doubt), it would give a revenue of £10,000 per annum during the first fifteen years (a sum which would be nearly equal to the estimated expenses of water supply and sewers for that period), and during the subsequent fifteen years the income from the same source would probably amount to £20,000, a sum that would much more than cover these charges."

In estimating the character and value of Mr. Wicksteed's sewerage scheme, although great fault has been found with it, I think it ought to be admitted that considering the views held, and the lack of experience at that time, it was a very able and enlightened effort to deal with a difficult question, and that it fairly met the wants of that day, and it is a somewhat singular coincidence that the thirty years for which Mr. Wicksteed estimated his sewers adequate has just expired, and our experience proves that the time has come when some important alterations must be made. The carrying out of the scheme undoubtedly effected at once an enormous improvement in the sanitary condition of the town; the sewers being laid deep had the effect of draining the shallow wells and of leading to the new waterworks supply being substituted.

The working of the main sewers was for some time satisfactory, and their construction, though it has been much decried, was not so bad as has been sometimes represented, being formed mostly with double brick rings, and intended to act as subsoil drainers to some extent. They must have been fairly well executed, no serious collapse having occured. Considerable cleansing has, however, of late years been necessary, the deposit being principally road *detritus*, and caused in a measure by insufficient engine power at the works, the sewers having been left gorged for a long time together. As seen in the light of experience, however, the weakest point was the insufficient size of the main sewers; for years this has led to cellar flooding, and it was an especial weakness with the central sewers. The large area of rising and

high land which finds its natural drainage line through the centre of the town, has intensified this state of things year by year as the districts became built over. The Gallowtree Gate sewer, for instance, was laid down 24in. in diameter, being 3in. less than originally intended, and a glance at the district of the London Road beyond, and its great elevation will show at once that the difficulty must arise. The storm waters gorge the sewers and the pressure due to the head in the higher levels causes the water to rise, as from a fountain, into the basements. This has been remedied to some extent by storm water sewers, and part of the district has a duplicate system, *one* solely for storm water.

From observation the construction of main sewers of insufficient size, appears to be a frequent cause of weakness and difficulty. The trunk of a tree grows with its extending branches, but a trunk sewer remains the same, and too often becomes overcharged by the great number of subsidiary sewers attached to it in course of time; and sometimes such sewers are made to do duty for a district beyond the ordinary natural watershed, as it is possible for engineers to pierce a ridge and so to get a fall into an existing sewer. Local Boards are apt to encourage such operations, in order to postpone the expense necessary for the construction of a new main sewer for the district unprovided for.

I think, however, that Mr. Wicksteed should receive some consideration in this matter; in fixing the size of his main sewers he took a middle course, whereas he estimated that in thirty years, five million gallons of sewage per day would have to be provided for, he calculated his mains to be capable of delivering twenty-eight million gallons. Mr. Wicksteed was necessarily influenced by the means at his disposal, and even then, on his moderate estimate of fifty-five thousand pounds, the General Board reported, as we have seen, that a much better scheme might have been devised at much less expense. Of course, the greatest portion of expense was for the main sewers, and it is not easy to see how Mr. Wicksteed could have increased the size of his main sewers, without greatly increasing the cost of his scheme.

In reference to the undertaking of the Patent Solid Manure Company, their works for treatment and manufacture were opened in May, 1855. The new sewers and the lime treatment soon caused an immense improvement in the river and canal, both in the neighbourhood of the town and below. The supply of the dried manure, however, from the first, much exceeded the demand. At the end of twelve months working, the original centrifugal machines were superseded by those of Messrs. Manlove & Elliott, of Nottingham. At the end of two years there

was an immense accumulation of the dried manure in the form of brick stacks, and the order to discontinue all processes for artificial drying was given—this having the effect of at once greatly reducing the working expenses. The further operations of the company were confined to the pumping, and the treatment by lime of the sewage, simply running the sludge into earth-banked receptacles. During the third year of working, however (viz.: on the 25th November, 1858), the Corporation took responsibility of the operations, and the Company handed over the works.

The Corporation continued the lime treatment, and the accumulations of sludge have gone on from that time to the present, what has been removed having been mostly given free to parties who would undertake the cost of removal. Various other recognized modes of treatment, however, besides the lime have been tested. In 1868, the A.B.C. company experimented for some time. In 1871, the Phosphate of Alumina Company used their system and had possession of the works altogether for about 18 months. In 1877, the patent of Mr. Hillé was worked for some months. Black ash has also been tried. During the past two years, the compound treatment recommended by eminent chemists has been applied, viz :—Lime, Alumina, and Sulphate of iron, and this season, in addition, the effluent has been deodorized by permanganate of soda as largely used in the Thames by the Metropolitan Board of Works.

The two last exceptionally dry seasons have put a great strain upon the resources of the Corporation at their works and there being for a long time together during the summer droughts no water flowing, other than the small quantity passed from one pond to another by a very slender canal traffic, the river below the town has, at the end of the summer, been composed mainly of the Leicester sewage effluent.

In September last year an enquiry into the condition of the Soar was held in Leicester by Major Tulloch, R.E., of the Local Government Board, at the instance of the adjoining authority, on the downward course of the river. The enquiry resulted in a decision that the state of the river was too bad to be much longer tolerated, and the Council undertook to proceed at the very earliest time to consider the matter with a view to an improvement, and this they have been engaged in doing during the last year. Looking to our experience one point was by most people considered settled, namely, that the mere treatment by lime or chemicals would not meet the case of Leicester, and that the application of the sewage to land was the only solution. It was also decided that the brave attempt which Mr. Wicksteed and those associated

with him had made to prove it true that sewage treatment might be so managed as not only to yield common interest but large profits, was a fallacy, though very creditable to them. We are no longer under such illusions, our efforts must be directed to minimise the loss, and our object should be to keep down the capital expenditure, and also the working expenses as much as may be compatible with efficiency.

In our consideration of this very important question, preconceived opinions and the schemes of the past, of course, came under review. A "free outfall" had been so much in the minds, and the phrase upon the tongues of those who had considered and discussed the subject, that almost everybody had come to the conclusion that this was the thing to be sought after, the phrase sounded well, but, it is to be feared that the conceptions of many of those who summed up their ideas of the problem by the demand for "a free outfall" were of rather a vague character; at any rate, no clear description has ever been given of what was intended or how it was to be obtained. A free outfall and a gravitation scheme is no doubt quite right theoretically, but practically it was found that even if at all attainable it would be most costly and difficult in the Valley of the Soar. On the whole, the Soar Valley Schemes for sewage disposal appeared to the committee fraught with risks too many and too great to encounter.

Another proposal was made, viz., to utilise and extend the present pumping outfall station, and lift the sewage to a height of 150 to 170 feet on to an estate of about 1,360 acres under the control of one owner, at a distance from Leicester of only 1½ miles. On 30th June last the council approved a report from the highway and sewerage committee, that 100 acres of this estate should be purchased, and the remainder leased for 30 years at an annual rent of 45s. per acre. The idea of the Committee is to use this mainly as a broad irrigation area, and it is confidently believed, that with this estate in hand, the Corporation will be able to deal with the sewage of the town without risk or interference for many years to come. The Inspector of the Local Government Board has expressed himself favourable to this scheme, and it is quite expected that it will be carried out. The Council at the present time await the official report of the Local Government Board to their memorial in favour of the scheme, and requesting authority to raise the requisite funds.

[*For discussion on this paper see page* 198.]

On "The Drainage of Continental Towns," by J. GORDON, M.Inst.C.E.

INTRODUCTORY.

IT is presumably owing to the Author having resided for over fifteen years upon the Continent as a practising Sanitary Engineer, that the Council of the Sanitary Institute has requested him to prepare a paper under this heading.

The subject is, however, such a comprehensive one, that, even with the advantage just alluded to, it is scarcely possible to do it justice within the limits of a single paper. It is also obvious that, even with the fullest and latest details available, they could not be fully utilised on the present occasion. The Author proposes, therefore, dealing only with the leading features of such representative instances of Sewerage and Sewage Disposal Works as have come more immediately under his own observation during the time referred to. In doing so, he would observe that a paper fully describing the complete works of any one town would probably give a clearer idea of the amount of attention paid on the Continent to the theory and execution of such works, where they have been undertaken, than can be conveyed by a paper on the more general question. The latter, however, doubtless possesses the greater degree of interest for this Congress, as bearing upon the position and prospects of foreign sanitary work, and comparing these with the corresponding elements in our own country.

HISTORY OF THE SANITARY MOVEMENT IN GERMANY AND SWITZERLAND.

Referring more particularly to Germany, in which the greatest advance has been made during the past twenty years, it may be said that the active prosecution of sanitary measures was for a long time considerably behind our English experience, in other words, no such exciting stimulus there existed as the Public Health Act of 1848 has been proved to be in this country. The exception to this statement is to be found in the case of Hamburg, which, at the passing of that Act, was considerably advanced in the execution of a well-devised system of sewers,

based on the example set by the late Mr. John Roe, surveyor to the Holborn District of London, who had adopted the egg-shape for brick sewers, and introduced flushing gates for cleansing them.

The great Hamburg fire of 1842 had destroyed so large a portion of the city as to involve the preparation of plans for its rebuilding, a project which included a general system of sewers. The design and execution of the latter were entrusted to Mr. W. Lindley, an English engineer, who, to some extent following up the London experience already referred to, adopted an oval sewer section in preference to the then prevailing vertical sides and flat bottoms.

After Hamburg, Berlin was the first city of importance to recognise the necessity for an improved system of sewerage; but it was not until 1860 that a commission of engineers was appointed to report on Belgian, French, and English towns, with a view to the preparation of a scheme for the Prussian capital. As the result, an elaborate plan and report were prepared by Privy Councillor Wiebe and Mr. Veitmeyer, civil engineers.

Closely following the publication of the Berlin Report, Mr. Eckhardt, the city engineer of Frankfort-on-the-Main, presented a report, which was referred to a commission of experts, who, in August, 1863, presented a report laying down the general principles upon which the sewerage system should be designed.

An important report on the town of Dantzic, which gave an undoubted impetus to the sanitary movement throughout Germany, and one of a most exhaustive and detailed character, was presented in 1865 by Privy Councillor Wiebe, in the preparation of which he was again assisted by Mr. Veitmeyer. The works recommended in this report were, however, not commenced until the Frankfort works were well in hand. Mr. Wiebe continued to advise the municipal authorities throughout the works, but by an arrangement between the city authorities and Messrs. J. & A. Aird, the general contractors for the work, Mr. B. Latham was called in to prepare the working plans for the works, which are familiar to English engineers through being illustrated in Mr. Latham's well-known book on sanitary engineering.

About the same time, Mr. Bürkli-Ziegler, town engineer of Zurich, was commissioned by the authorities of that town to go over the same ground as in the case of the Berlin Commission, with a similar object as regards Zurich, the question of water supply being added. His illustrated report of March, 1866, at once established his reputation, and, with that of the

Berlin Commission and the Dantzic Report, became a text book for Continental engineers, so that a new departure may be said to have been made in Germany and Switzerland dating from that period.

Somewhat later (1868) a valuable report and book of reference appeared on a proposed scheme of sewerage for Stettin, by Mr. Hobrecht, civil engineer, who is now chief engineer to the Municipality of Berlin.

In January, 1866, Mr. Lindley and the Author were appointed to design and carry out the Frankfort sewerage works on the general lines and principles laid down in the report of the 1863 Commission, of which Mr. Lindley had been a member. Owing to the war between Prussia and Austria in 1866, it was not until the following year that a commencement was made with the works, the special character of which soon became widely known, in consequence of the attention directed towards them by the meetings of various scientific bodies being held in the city, and also by the visits and subsequent reports of municipal engineers and sanitary specialists.

The vacuum pneumatic system of Capt. Liernur was about the same period first brought prominently before the public, and served in several instances to retard for years the adoption of any system of filth removal in towns, which felt the necessity of amendment, but which were ready at the same time to acquiesce in delay, until the battle of the systems had been fought out at the expense of others.

The town of Basle, in Switzerland, was next reported on in 1872 by a commission of engineers, consisting of Messrs. Lindley, Wiebe, and Bürkli-Ziegler.

Reports now followed upon other towns, amongst which may be mentioned, in the year 1873, Breslau, Winterthur, Mayence, Bochum, and Düsseldorf.

After having completed the chief and more difficult portions of the Frankfort works, the Author reported upon and prepared plans and estimates for sewering the following cities and towns: Stuttgart, Heilbronn, Hanau, Landshut, Munich, Bockenheim, Dortmund and Ludwigshafen, with an aggregate population of 530,000. He also reported on schemes of sewerage prepared for Nuremberg and Homburg, and acted as engineer for the contractors in the execution of the sewerage works of Düsseldorf, Crefeld, and Linz (Austria), and for similiar works at Carlsruhe and Darmstadt, representing, including the first-named towns, a population of about 983,000.

Mr. Lindley has also reported on Crefeld and Elberfeld, as well as St. Petersburg and Warsaw, and on additional works at Homburg.

Mr. Bürkli-Ziegler, in addition to having carried out a complete system of sewers at Zurich, has reported upon and prepared schemes for Heidelberg and Mannheim, and, in conjunction with Professor Kulmann, of Zurich, for Bucharest.

Mr. Hobrecht, of Berlin, must be mentioned as having inaugurated, and being now engaged in completing an entirely different scheme to that propounded for Berlin by the 1860 commission, he has also reported on Mayence, and other places.

Comprehensive schemes have also been prepared for sewering the towns of Gotha, by Mr. Hennoch; Freiburg in Baden, by Mr. Lueger; Riga, by Mr. Malcher; Königsberg, by Mr. E. Wiebe; and for Vienna by the town engineers, Messrs. Niernsee, Arnberger and Berger; while the Liernur system has been introduced at Leyden, Dordrecht and Amsterdam; and the town of Winterthur, in Switzerland, has had under consideration the adoption of the same system, but has now abandoned it.

It will be seen from this hasty enumeration, that the adoption of sewerage works upon the general lines of the English water carriage system is steadily progressing on the Continent of Europe; and attention may next be directed to the leading principles on which these works are based as a whole.

Leading Principles of Sanitary Works on the Continent.

The Franco-German war of 1870—71, considerably interrupted the progress of the Frankfort works, and retarded the adoption and commencement of similar works throughout the country; but since then much good work has been done, that is to say, good work as far as it goes, for it will no doubt be considered by this Congress that many of the works, which the author is about to describe, are imperfect in two essential particulars, viz., in the ultimate disposal of the water-carried sewage, and in the exclusion in many instances of the excreta from that mode of conveyance in towns where complete and thoroughly efficient systems of sewers have been laid down. Further reference is made to both these points in the following recapitulation of the leading principles adopted.

Rainfall.

Contrary to the practice long greatly recommended, and now frequently, if only partially, adopted in England, nearly the whole of the sewerage schemes to which reference has been

made are designed to accommodate the rainfall in addition to the ordinary sewage by one set of sewers.

In Frankfort a rainfall of seven-eighths of an inch in twenty-four hours has been provided for, without bringing the storm overflows into action.

In Dantzic the engines and pumps are calculated for a rainfall of one-quarter inch per day of twenty-four hours, to be pumped to the Irrigation Works; but irrespective of this, the outfall sewer is large enough to allow of men passing through it. The tributary sewers are calculated to discharge a fall of half an inch per hour, the main trunk sewers (leading to the outfall) being relieved by storm overflows.

In Berlin it was intended, by the original scheme, to provide for half an inch in twenty-four hours, but this was altered in the report of a commission to $\frac{5}{16}$ of an inch per hour, or fifteen times the original limit.

Mr. Bürkli-Ziegler made a larger provision for rainfall in Zurich than in any of the preceding cases, and in the Mannheim and Heidelberg schemes provided for $\frac{3}{8}$ of an inch per hour.

In the Author's schemes, designed after Frankfort, he has always endeavoured to provide for the main trunk sewers being capable of carrying off at least an inch of rainfall to the main outfall in twenty-four hours, without bringing into play the storm overflow sewers, the subsidiary sewers being designed to take from $\frac{1}{4}$ to $\frac{1}{2}$ an inch of rain per hour, according to the extent of the district drained, the general declivity thereof, and the average distance from an overflow outfall.

The greatest exception he has met with in the most recent returns which have been obtained is that of Mayence, on the Rhine, where the rainfall, for which the new sewers are said to make provision, is given at 30 millimetres in half an hour, one-half of which is expected to reach the sewers in that time, and be carried off by them when the storm overflows are brought into play. This is equivalent to $1\frac{1}{5}$ inches of rainfall in an hour actually carried off, or, on the assumption of 50°/₀ reaching the sewers in the same time, to $2\frac{2}{5}$ inches of rain in the hour, and is therefore an unprecedented provision, leaving some room for doubt as to the accuracy of this return, when it is considered that the largest sewer of the system is not more than 5ft. 11in. by 3ft. 11in. in section.

In Cologne also an unusually large provision for rainfall is made, the main trunk sewers being calculated to carry off half an inch, and the subsidiary sewers $1\frac{1}{5}$ inches per hour. The largest main sewer, however, is in this case

8ft. 2in. by 7ft. 3in., with a contracted channel for the dry weather flow and a small footpath on one side, similar to the section adopted by the author for Munich, where, however, the main outfall sewer is not more than 7ft. 3in. in diameter.

Depth and Mode of Laying out Sewers.

In Frankfort, Munich, Stuttgart, and other cities and towns with which the author has been connected, the sewers have been laid at such depths as to insure a proper and efficient drainage of the cellars and basements of the houses, even when the sewers are running full, and of the laying of the house drains below the cellar floor levels, whether carried inside or outside the houses. Dead ends are also practically non-existent, owing to the sewers being laid at such levels as to join them to each other at street ends, thus making it possible to flush the lateral sewers from the main trunk sewers by means of flushing gates and stops, without having recourse to supplementing the flushing power from the water supply of the town; the system being by this arrangement, to a large extent, interchangeable and self-balancing no serious difficulty can possibly arise from any mishap in the way of a block, or in the case of one sewer being more surcharged than another, inasmuch as the branch sewers will always admit of the passage of the sewage or rainfall round a block until it has been removed. By such an arrangement so serious a block as was experienced in Leicester in 1881, in one of the main sewers draining an area of 316 acres, and with a length of 12¾ miles of sewers to the point at which the block occurred, would have been impossible.

Flushing Arrangements.

In Frankfort an elongated gallery or reservoir, into which land drains are laid to collect the subsoil water from the higher lying land beyond, has been constructed at the summit of the system, from which upwards of 100,000 gallons of water can be sent through almost any part of the system by means of the arrangements described. Two other similar arrangements are made at the summits or ends of the two lowest districts of the town, one on the extreme east, and the other at the west end of the city. The sewers may be said to be laid out in three zones—a higher, middle, and lower zone, the lateral sewers of each being capable of being flushed from the main trunk sewer of the zone imme-

diately above it, or having the flushing power from the galleries alluded to directed through them.

The system of sewers now in course of construction at Munich in accordance with the Author's plans is arranged on the same principle, as are also those of Stuttgart, Düsseldorf, Crefeld, Dortmund, and Mayence.

Those of Berlin, Dantzic, and Breslau, are also, to a great extent, carried out on the same principle, excepting that there are no special reservoirs constructed for flushing purposes, and the mode of flushing is of a somewhat more primitive character. In Berlin and Dantzic, a disc faced with india-rubber, with a rope or chain attached to it, is used. A workman descends a manhole and places the disc into the mouth of the pipe which carries the sewage forward from the manhole, and, if the manhole be at the crossing of two streets, with two pipes entering and leading from it, then a second disc is required. After inserting the discs, the workman brings up the ends of the ropes or chains to the surface, and waits until the sewage has backed up to a line marked on the inside of the manhole, which indicates the level to which the sewers may be backed up in that neighbourhood without back-watering the cellars. He then withdraws one or both of the discs as he may desire to flush one or both sewers. Personally, the Author thinks there are some objections and risks connected with this mode of flushing the sewers, as he pointed out to the author of it, Mr. Wiebe, when that gentleman showed him its working in Dantzic. It backs up the sewers and puts them under a greater pressure of water than is, in his opinion, wise, or than there is any necessity for; whilst on the other hand, reliance has to be placed upon the trustworthiness and patience of the workmen for watching that the water does not rise beyond the height fixed upon, which might easily have been provided for by an overflow in each manhole. In both cities the sewers are chiefly pipes, so that it is absolutely necessary with such flushing arrangements that the jointing of the pipes should be such as to withstand pressure. In Berlin they are made with oiled yarn and a fine plastic clay. The only thing the Author can see in favour of this method of flushing is that of economy in first cost, avoiding as it does the cost of flushing gates, hand penstocks, and other valve arrangements, as used in Frankfort and the other towns enumerated.

Materials and Construction of Sewers.

In Dantzic the sewers are chiefly pipes, not more than 10⅓ per cent. of the total length of sewers being of brickwork.

In Breslau the sewers are also chiefly stoneware pipes. The main sewers are of brickwork with large granite blocks for the invert.

In Berlin too, as previously referred to, the sewers may be said to consist almost exclusively of pipes, the main trunk sewers, which are of brick, bearing but a very small proportion in length to that of the pipe sewers. The largest sewer is 10ft. 1in. × 8ft. 9in., and the smallest 8 inches in diameter.

One noteworthy feature in the drainage of Berlin is the principle adopted of having a sewer on each side of the street, which, so far as the Author is aware, has not been attempted elsewhere. This principle has no doubt enabled the author of it, Mr. Hobrecht, to adopt pipes in cases where brick sewers would otherwise have been requisite, and accounts to a great extent for the great excess of pipes over brick sewers for a city of such a metropolitan character as Berlin, with its million-and-a-quarter of inhabitants, now is. Various reasons may be given for the choice of this system beyond that of desiring to confine the sizes of the sewers to that of pipes. The subsoil is surcharged with water, and consists of fine running sand, making it most difficult and costly to construct brick sewers watertight; but the means which had to be adopted to obtain this result must be passed over here, as being incompatible with the limits of this paper. The streets being generally wide, the adoption of a sewer on each side enabled the traffic to be carried on without interruption, and so shortened the length of the house drains that the necessary fall for them could be obtained without the street sewer being laid so deep as would have been requisite if one sewer had been constructed in the centre. It can scarcely be conceived, however, that the plan has not been more costly than if one sewer had been adopted. Another noteworthy feature in the sewerage of Berlin is also the theory of the engineer, Mr. Hobrecht, that to prevent the formation of sewer gases as much as possible steep gradients should be avoided. His argument is, that with branch sewers of steep gradients, a state of things is involved in which, during the night, and also with the minimum day flow, so small a portion of the invert of the sewer or pipe is covered by the flowing sewage as to leave a large portion of the sides of the pipe covered with slimy matter exposed to the action of the comparatively high temperature of the sewer. This acts upon and tends to dry it by evaporation, and thus to evolve in a greater degree a more pungent and dangerous sewer gas than would be the case if a greater portion of the surface of the invert could be kept covered with sewage flowing at a slower velocity. He urges also that branch sewers with steep gradients run practi-

cally dry, and that with a minimum flow matters that would float with a given depth of water on the invert are deposited and not removed by the greater velocity of the maximum flow, and that consequently, on this head also, it is better to ensure a sufficient depth of water on the invert moving at a velocity not more than sufficient to float forward all such solid matters as find their way into the sewers. Mr. Hobrecht has had the courage of his opinions, and has carried those views into practice by flattening all steeper gradients to 1 in 500, and any one inspecting the sewers of Berlin, as the Author has had the opportunity of doing, may see evidence of this at any of the crossings of the streets, where in a manhole may be found pipes coming in at different levels, sometimes two and three feet above the invert of the manhole or outgoing pipe, showing that the whole of the available fall for the ingoing sewers has not been made use of.

In Frankfort the largest sewer is 6ft. 1in. × 4ft. 8in., and the smallest brick sewer 2ft. 3in. × 1ft. 6in. Fifty per cent. of the whole of the sewers are of the size of 3ft. × 2ft., and only about 20 per cent. are of pipes.

The largest sized sewer in Munich is, as previously referred to, 7ft. 3in. in diameter, with a contracted channel for the dry weather flow, and a small footpath on each side.

The largest sewer for Stuttgart is 6ft. 7in. in diameter, similarly constructed, whilst the main sewers for Düsseldorf, Crefeld, Mayence, and Nuremberg are 5ft. 11in. × 3ft. 11in. The brick sewers in these cities are constructed of the very best brickwork built with the best Portland cement mortar. Nuremberg is an exception, the sewers there being constructed of cement concrete, as are also the sewers of Mannheim and Heidelberg and of nearly all towns in Switzerland (Basle, Zurich, &c.).

One-half of the sewers in Linz, in Austria, are built of brickwork with hydraulic lime, but of exceptional thickness, the other half are of cement concrete.

VENTILATION.

The system, first initiated on the Continent in connection with new sewers at Frankfort, of ventilating them by means of surface gratings in the centre of the roads and of trapping the street gullies, is now the most prevalent, and has in fact been adopted in all the towns with which the Author has been connected, with the exception of Linz. In Berlin, Breslau and Dantzic, it has also been adopted, although

probably not to such an extent as in Frankfort, Stuttgart Munich, Düsseldorf and Crefeld. In all those towns in which the water closet system is in vogue, and the closets are connected to the sewers, as in the towns just enumerated, with the exception of Crefeld and Stuttgart, the soil pipes act both as ventilators to the house drains and to the public sewers, and in this respect will probably meet with the condemnation of this Congress as contrary to the commonly received and now prevailing opinion of English sanitarians, that all house drains and pipes should be disconnected from the public sewers at a point between them and the houses. Whilst therefore the Author may not defend the practice on principle, he is bound to say that with thoroughly well-constructed sewers, such as he has described, without any dead ends, and with such ample provision for flushing and cleansing them, and a staff of workmen regularly employed exclusively on this duty, and with an equal amount of care bestowed on the designing of the house drainage itself, the system has so far been successful that practically scarcely any complaints have arisen as to the surface gratings having become a nuisance. The circulation of air within the sewers, and the great dilution of it with atmospheric air through the open gratings, placed so numerously as they have been in Frankfort and many of the other towns as to be only 40 yards apart, assisted as they are also by the rain water pipes, has resulted in the sewer air being (if such a description can be applied to sewers) comparatively sweet. If anyone wished to inspect the Frankfort sewers, and were desirous of avoiding what have been termed by visitors the show-places, where especially convenient staircases, &c., have been constructed, and would follow the example of a Government and Town Commission from Munich, by marking on a plan of the town any points they might choose, and desire to be shewn the sewers at those points, the author would be extremely surprised if they did not find the sewers comparatively free from smell, such as might be expected in the sewers of a thoroughly and completely water-closeted city of 147,000 inhabitants, with 26,900 water closets joined on to the sewers. The 7,570 soil pipes of cast-iron—all the new ones being varnished inside and outside, with Dr. Angus Smith's patent varnish—jointed with lead, carried through the roof with open tops, together with rain water pipes, act as powerful up-cast shafts, and materially assist in the ventilation of the street sewers, and in keeping up a continuous circulation and dilution of the air within the sewers and house drains.

The Author must, however, also state with reference to Frankfort, that two special shafts, each 100 feet high, and of 5 feet internal diameter, were built at the two summits of the

system to assist in the ventilation of the sewers, but that whilst they are powerful ventilators within a given radius, it would take a very large number of such shafts indeed to be of much service.

TABLES.

It is impossible within the limits of such a paper to dilate on each particular case, but for all those anxious to become acquainted with more of the details of each city, the Author has appended what he hopes may be an interesting and useful summary, in as condensed a form as possible, giving the latest information with respect to the sewerage and sanitary condition of a large number of continental towns.

He takes this opportunity also of most heartily and cordially acknowledging the courtesy and readiness with which magistrates, mayors, and city engineers throughout Germany, Switzerland, Austria, Holland, Belgium and France have supplied, at great labour and trouble, the fullest information with regard to the sewerage works executed in their respective cities, together, in many instances, with elaborate details relating to the mortality before and after the execution of the works of drainage. There have been one or two exceptions, notably Gotha and Mannheim, where information has been refused. The Author trusts, however, that the collection of information appended to the paper, even in its condensed form, will to some extent repay all those who have so readily contributed their quota to it, and he can only regret that it is impossible to do justice in the present paper to such valuable material as is now in his hands, but as many of the town authorities referred to are looking forward to its publication, he purposes dealing with it hereafter in a more detailed form, and in such manner that he hopes its publication will be assured.

HOUSE DRAINAGE.

Very great attention has been paid to the character of the work in carrying out the house drainage in most of the towns which have been enumerated. Comprehensive and stringent regulations have been issued, and special offices established on behalf of the authorities, to check, correct, and amend all plans sent in for approval, whilst a sufficient number of inspectors has been appointed to see every pipe laid. In the case of Frankfort, so far back as 1868, regulations, drafted by Mr. Lindley and the Author, accompanied by a series of drawings

illustrative of the manner in which the drainage was required to be carried out, and of the character of the drawings which would be required to be sent in by all persons proposing to drain their houses, were issued. The use of varnished cast iron water pipes was, the Author believes, for the first time proposed in these regulations and made imperative for all drains, soil pipes, fall pipes from kitchen sinks, urinals, &c., of upper storeys within the houses. It has already been stated that the soil pipes are not disconnected, but act together with a large number of the rain water pipes as ventilators to the house drains and public sewers. On the other hand, all the remaining branches passing into the interior of the buildings were cut off by a syphon placed outside the house in a circular brick shaft or manhole 3 feet in diameter, with a proper cover to it as a means of access. This was subsequently abandoned, or at any rate not made compulsory by the magistrates of Frankfort, owing to the syphons not being periodically seen to. The severity of the climate in winter made it impracticable to disconnect by delivering on to surface gratings, and many explanations and reasons might be given on this head which must be passed over in this paper.

The houses on the continent are chiefly on the flat system, so that the kitchen sinks and water closets were generally in tiers one above another. This facilitated the extension of the soil pipes and waste pipes of the kitchen sinks, lavatories, baths, or urinals through the roofs, and this system was made obligatory by the regulations, so that the house drainage generally is well ventilated, independently of special pipes not infrequently carried up to the roof from the end of house drains.

Junction blocks and pipes were built in as the street sewers were constructed, and their position carefully noted and put on to the town plans, and in practice it was found that not more than about two per cent. of the houses in Frankfort required other blocks or junctions than those provided. This the Author considers of great importance in all well-regulated systems of sewerage, as nothing is more destructive or injurious to sewers than breaking into them for the purpose of making side connections, a matter in which some experience has been gained in Leicester.

Duplicate copies of every house-drain plan, with sections of every branch and tier of closets or sinks, showing every junction pipe and connection to a scale of 10 feet to the inch, are deposited with the authorities, and these plans, showing the gradients and depths of the drains with the interior arrangements of the house, are again transferred to the town plans drawn to a scale of $\frac{1}{240}$ natural size, or about 20 feet to the

inch, so that the authorities are in possession of a set of plans, of a kind entirely unknown, the Author believes, to any English or other municipality outside the confines of the German Empire.

The same care and attention is devoted to these points in Munich, Stuttgart, Düsseldorf and Crefeld, but so far as the Author is aware only Hamburg, Frankfort, and Mayence are favoured with an elaborately detailed survey to so large a scale as $\frac{1}{250}$.

Old Sewers.

A noteworthy feature in the sewerage of Frankfort, and one which the Author believes has not been attempted elsewhere, was that of abolishing and not merely putting out of use, but opening out and filling up the old sewers, and all their ramifications, as soon as the house drainage was sufficiently advanced to admit of this being done.

Sewage Disposal.

The question of sewage disposal has made but comparatively little progress on the Continent. This arises from a variety of causes. There are not such a large number of towns yet that have adopted the water carriage system in its entirety. The chief towns that have done so are: Berlin, Frankfort, Munich, Dantzic, Düsseldorf, Breslau, Linz, Hamburg, Brussels and Rotterdam. In Stuttgart, Crefeld, Dortmund, Ludwigshafen, Mannheim, Darmstadt, Heidelberg, Mayence, Basle and Zurich, although new systems of sewers have either been constructed or are in course of construction, thoroughly and completely adapted to the water carriage system, the authorities have not yet made up their minds to admit the drainage from water closets into them. Much might be said in reference to the methods adopted for the collection and removal of the excreta in these towns where it is not admitted into the sewers, but it would be quite beyond the limits of this paper. It may generally be said that where the cesspool system is in vogue, as in Stuttgart, Carlsruhe, Strasbourg, Dortmund, Ludwigshafen, Landshut, Hanau, Crefeld, &c., they are supposed to be of a watertight character, and perhaps one of the best regulated towns in this respect is Stuttgart. The cesspools are here small, and the emptying of them is in the hands of the authorities. This is done on the pneumatic system, so as to avoid nuisance from the operation, but the Author cannot say that it is always successful in this respect, although no doubt much that is unpleasant is due to the carelessness of

the workmen. Specially designed boiler railway waggons, carrying three small boilers each, have been built, by means of which a large portion of the manure is sent long distances into the country. Large reservoirs have been built near the town for storage when it does not suit the farmers to take the manure. Storage tanks have also been constructed at various stations along the railways, from which the farmers can draw at their convenience, and the emptying and filling even at these stations is all done on the pneumatic principle. For many years after its establishment in 1873, the loss upon the cost of the collection of the manure was considerable, but within the last year or two the receipts more than balance the expenditure. It must not be supposed, however, that the receipts are only from the sale of the manure. They are chiefly from the house-owners or occupants, who have to pay from 3s. 9d. to 5s. for every ton of manure removed. The income from this source amounts to 67½ per cent. of the total receipts.

In Carlsruhe and Strasbourg the same system is in force, but with this improvement, that the engine which creates the vacuum in the boilers goes with the latter and pumps the air from the boilers through the furnace fire, so that all possibility of a disagreeable smell escaping during the operation is prevented in a much more perfect manner than at Stuttgart and elsewhere.

At Heidelberg, Nuremberg, Gratz and Zurich, the tub system is in force, after the fashion of that in use for a considerable portion of Paris, with the exception that at Heidelberg and Nuremberg the urine is retained in the tub, whilst in the other cases it is allowed to pass into the sewers. Notwithstanding this the town of Zurich has had to adopt the system of irrigation to prevent the pollution of the Limmat.

Paris, as is well known, has also had to adopt irrigation at Gennevilliers, although on much too limited a scale, as only a very small portion of the sewage of the city is dealt with.

Berlin and Dantzic are the most successful examples of irrigation on the Continent. These two towns are most fortunate in the selection of their irrigation areas, both consisting of nothing but sand as a subsoil, that of Dantzic being, in fact, a sandy waste on the sea shore, and, previous to the application of sewage to it, without any covering of soil.

Frankfort, originally intended to be dealt with by irrigation, is the only city at present on the Continent, so far as the Author is aware, which has finally adopted the system of precipitation on a comprehensive scale. Wiesbaden, a town of importance and well known to English tourists, is also constructing at the present moment settling tanks to deal with

their sewage before it enters the small stream into which it is at present delivered. The adoption of a more comprehensive scheme of sewerage is also now under consideration.

A proposal has been made for dealing with a portion of Homburg in this way, and settling tanks were designed by the Author and carried out for Dortmund, but with the ultimate object of intercepting the grosser solids only after the town had adopted the water-closet system, for which an irrigation area was selected for the ultimate disposal of the sewage.

Proportion between Flow of Rivers and Sewage.

The rivers of the Continent are much larger, and the populated towns upon their banks much smaller, in proportion to those of the United Kingdom, consequently the dilution of the sewage finding its way into the streams is so very much greater than we are accustomed to in England, that the pollution of such streams as the river Main, the Rhine and the Danube, is, as compared with that of our own rivers, infinitesimally small. Take for instance the river Main, at Frankfort. Its exceptionally lowest summer flow is about 2,400 million gallons per day, or 600 times that of the dry weather discharge from the sewers of Frankfort, whilst there is no town of importance below the point of sewage discharge until the river Main joins the Rhine, 22 miles lower down. The lime process, or any other of the chemical methods of precipitation which would clarify the sewage, would therefore no doubt be sufficient in such a case.

The Rhine at Basle, in Switzerland, has a flow of 19,016 million gallons per day, and at Cologne 28,500 million gallons per day, the distance between these cities being 580 miles. The chief large towns on its banks between the points named are Speyer, Mannheim, Ludwigshafen, Mayence, Coblentz and Bonn, with an aggregate population, including Basle and Cologne, of about 405,000, so that the volume of sewage effluent would range from 1 to 9,186 of that of the river at Basle, to 1 in about 2,345 at Cologne, even if the whole of these populations were pouring their sewage into the Rhine at the latter point, instead of its being distributed over a distance of 580 miles.

In all these cases a fairly good effluent resulting from the adoption of any chemical precipitating process would probably meet the case, were it not for the fact that some of these towns, notably Cologne and Düsseldorf, in the lower reaches of the river, draw practically their water supplies from the Rhine, their pump wells being sunk close to the banks of the river.

The following summary shows what has been done, and what money has been spent on new sewerage and sewage disposal works in 33 of the chief towns :—

	Length of Sewers in Miles.	Expenditure on Sewerage Works. £	Expenditure on Sewage Disposal Works. £	Total Expenditure. £
Basle	11	27,560		27,560
Berlin	286¾	1,332,000	1,505,968	2,837,968
Bochum	7½	15,000	.....	15,000
Breslau	74	316,554	.....	316,554
Brussels	74½	400,000	.....	400,000
Carlsruhe	21¾	110,000	.....	110,000
Chemnitz	25¼	70,000	.....	70,000
Cologne	18¾	61,500	.....	61,500
Crefeld	12½	72,644	.....	72,644
Dantzic	27¾	125,000	.....	125,000
Dortmund	6¾	28,700	1,300	30,000
Düsseldorf	4¾	54,000	.....	54,000
Eisenach	1¾	6,675	.....	6,675
Erfurt	24¾	21,000	.....	21,000
Frankfort-on-the-Main	100	517,861	28,759	546,620
Halle	27¼	55,000	.....	55,000
Hamburg	141¾	905,000	.....	905,000
Hanover	49	107,500	.....	107,500
Heidelberg	6½	20,000	.....	20,000
Homburg	3½	8,700	.....	8,700
Königsberg	5	15,000	.....	15,000
Leipzig	55¼	165,600	.....	165,600
Linz	12¼	64,600	.....	64,600
Ludwigsburg	4¾	10,113	.....	10,113
Ludwigshafen	2¼	12,050	.....	12,050
Mayence	15	59,000	.....	59,000
Munich	27½	200,000	.....	200,000
Nuremberg	41	295,000	.....	295,000
Paris	536¾	4,200,000	.....	4,200,000
Stuttgart	17½	92,250	.....	92,250
Vienna	151½	500,000	.....	500,000
Wiesbaden	16¼	40,000	.....	40,000
Zurich	50	109,460	.....	109,460
Totals	1860¾	10,017,767	1,536,027	11,553,794

The detailed returns from Berlin are of an elaborate character, but cannot be dealt with in this paper. They are especially interesting as giving details of what are probably the largest irrigation works in the world for the disposal of town sewage, the area of land irrigated being over 13,000 acres.

Rates of Mortality.

The mortality returns from the various towns show that there is generally a marked improvement after the execution of the drainage works, although it would probably be unfair to claim that this is entirely due to these works, because in all probability as much is due to new supplies of water having been carried out at the same time. This is especially noticeable in Dantzic, as will be seen from the following Table by Dr. Albert Liévin :—

Before the execution of Sewerage and Water Works.				After the execution of Sewerage and Water Works.			
Year.	Mortality per 1,000.	Epidemics occurred.	Deaths from Typhoid Fever per 1,000.	Year.	Mortality per 1,000.	Epidemics occurred.	Deaths from Typhoid Fever per 1,000.
1863	36·71	Measles... ...	11·2	1872	31·39	Small-pox ...	8·0
1864	31·29	... ...	7·6	1873	26·50	Cholera ...	4·1
1865	34·60	... ...	9·8	1874	25·28	... ...	5·1
1866	49·18	Cholera ...	9·6	1875	30·80	Diphtheria ...	3·3
1867	34·80	... ...	12·3	1876	28·72	... ...	2·6
1868	40·00	Scarlet Fever	12·3	1877	29·01	Diphtheria ...	2·7
1869	29·53	... ...	8·9	1878	29·33	... ...	1·9
1870	30·98	... ...	7·0	1879	28·64	Measles ...	1·8
1871	41·51	Small-pox and Cholera ...	11·0	1880	31·51	Diphtheria ...	0·8
				1881	26·68	... ...	1·4
Aver.	36·51		9·97	1882	29·09	Infantile diarrhœa ...	2·1
				1883	27·02	... ...	1·0
				Aver.	28·66		2·9

In Mayence an improvement took place during the progress of the works from 1875 to 1877, but there was no further improvement until the works were resumed in the beginning of 1880, the death rate having improved every year since as the works have progressed.

Concluding Remarks.

The author feels, in bringing this paper to a close, that he must have trespassed on the patience of his hearers by the length of the paper, but trusts that the largeness of the subject which he has endeavoured to deal with will be taken as some excuse for introducing it, in the hope that it may be followed further by dividing it into branches with profit to every sanitarian, and more especially to every municipality, inasmuch as it must be of immense importance to the community at large that the

municipalities of Europe should know what other governing bodies are doing in regard to the improvement of the sanitary condition of the city or town over which they have control, and to have the opinions of sanitarians generally on the course each municipality has thought fit in its wisdom to adopt. If, therefore, the paper has no other effect than to direct attention to the system and regulations which each municipality has adopted, and to lead to a rejection of that which is condemned by sanitarians, and an adoption of that which is approved by them, the object of the Author will have been fully served, and the labour bestowed on the collection of the information respecting continental towns amply repaid.

[*This discussion applies to the two preceding papers by* Mr. J. UNDERWOOD *and* Mr. J. GORDON.]

Mr. PERCIVAL GORDON SMITH, F.R.I.B.A. (London), said, from the first paper a great deal might be learned as to what to do and what to avoid. Mr. Gordon's paper was one of the utmost value. It was a unique record of the sewerage arrangements of different countries, and contained information that was very much wanted in this country. As a rule we did not know sufficient about the details of what was being done in other countries, and on the subject of sewage treatment this paper appeared to supply the deficiency. He had often wished that the British Government would depute commissioners to visit the different foreign countries, and to report upon what was going on in regard to health matters generally—if only to teach us what to avoid. In the matter of sewage treatment this paper contained a vast amount of information which could not fail to be most advantageous in our future works. Both papers went to prove one very important point—viz., that we must not aim in the least at making a profit out of the products of sewage. The first object should be to get the sewage out of the town, and next to dispose of it in a way that should not pollute the streams or the land or the atmosphere. Having attained these two objects, every effort should be made to carry on the works at the least possible loss rather than at a profit. If any local authority could make a profit out of sewage let them do so by all means, but never at the expense of the efficiency of the system.

Mr. J. LEMON (Southampton) agreed that the idea of making a profit on sewage was altogether illusory. They must now look to getting rid of it at the least possible cost. Sewage management should be left to the local authorities, and never entrusted to public companies, who sought to earn a profit. The inhabitants of Leicester appeared pretty well agreed that the present system of sewerage,

which subjected the low-lying districts to periodical floods, must be removed at any cost. He suggested that the town should be divided into zones for the separation of the high level system from the low level, and the consequent avoidance of floods. He had carried out this principle elsewhere, and had found it to answer admirably. A pumping station might be placed at the gravitating point of the high level and an ejector adopted for the relief of the low level. He asked the Corporation of Leicester to pause and seriously consider the responsibility they were about to assume in raising the sewage 170 feet. There was no excuse for it whatever, unless the land was exceptionally adapted to the purpose. This, he believed, was not the case. No doubt it was the intention of the Corporation of Leicester to dispose of the sewage by what was known as "broad irrigation." If they had a good subsoil and everything were favourable, broad irrigation was the right system. But in Leicester he feared those conditions were absent. For instance, it must not be lost sight of that the river Soar could never attain a very high standard of purity. He was inclined to think that a lift of 70 or 80 feet, with a combined system of precipitation and intermittent filtration over a smaller area, would answer all the purposes of Leicester, and could be carried out at a very much less cost. As to Mr. Gordon's paper, he believed French engineers were now alive to the evils of the Continental system. The sooner the prevalent idea was removed that sewage should be made a profitable speculation, the better.

Prof. H. Robinson, M.Inst.C.E. (London) assumed that the scheme for the sewerage of Leicester had received careful and mature consideration, and had been approved by Mr. Gordon. On this assumption, and without all the data bearing on the subject, it would not be desirable or possible to enter into a critical examination of the scheme. Looking at the matter broadly, however, there must be some good reason which was not apparent to him (Prof. Robinson) why all the high level sewage should be brought to a low level outfall, and for the whole to be pumped the great height of 170 feet on to clay land, which was unsuitable for sewage irrigation. The scheme would involve a serious burthen to the town of Leicester. It was desirable to exclude as much of the rainfall from the sewers as possible. Mr. Gordon's was one of the most valuable papers he had ever heard read, and contained data of interest to all engineers engaged in sewage disposal practice, and the Institute was fortunate in having this contribution to the proceedings.

Mr. Alderman Kempson (Leicester), admitted that the land taken by the Leicester Corporation for their sewage works was not altogether suitable for the purpose, and explained that the difficulties in the valley sites were in the opinion of the Town Council insuperable.

Lieut.-Colonel Jones (Wrexham) remarked that as he had resided in his neighbourhood (Leicester) many years ago, before entering upon

his Sewage Disposal Works at Wrexham, he had always watched with much interest the Leicester experiments, and he congratulated Mr. Underwood on his excellent history thereof.

In entering at last upon sewage farming as the best mode of purifying their sewage, the Leicester Corporation should not be discouraged by the low estimates now prevailing on the financial side of the question, as the pendulum of public opinion will probably come to rest eventually about midway between the two extremes which it touched some twenty years ago and to-day. He would not presume to criticize, as others had done, the decision recently arrived at by the Leicester Corporation, because there were so many considerations which govern such questions not laid before their meeting, and he preferred to assume that the skilled advice of such an able engineer as Mr. Gordon had its due weight in any decision on such an important matter.

Mr. Peregrine Birch (London) was glad to hear from Mr. Alderman Kempson that the decision come to by the Corporation of Leicester was based, as he should have expected, upon information carefully obtained; and he thought that London engineers would be unwise to give opinions on the subject until they had the same means of arriving at a sound judgment.

With reference to Captain Lienur's system, the cost of dealing with the quantity of water made foul in English houses renders this method prohibitive here. He had himself adopted the plan mentioned by Mr. Gordon of laying a sewer under each pathway instead of one in the centre of the road. The advantages of this plan in wide roads, in saving the length and increasing the gradients of the house drains in which sewer gas is formed even more than in the sewer itself, is obvious. With regard to the 13,000 acres of land said to be irrigated at Berlin, he should like to know whether the land was pasture or arable, and whether irrigation was carried on constantly or only occasionally. Mr. Gordon had said that only a very small portion of the sewage of Paris was dealt with by irrigation; this was so, but a very large and increasing area of land was irrigated upon the optional system—that is, when the occupiers of the land required it for their crops.

The area of land in the Plain of Gennevilliers now sewaged in this way amounts to nearly 2,000 acres and this has grown up gradually from the start of a few acres some 15 years ago. He was surprised to hear from a previous speaker that the Soar must always be a foul river, and he should like to know why.

Mr. Laws (Newcastle-on-Tyne) was in favour of the ventilation of sewers through the soil pipes, provided the drainage system was properly carried out. Of course it was not advantageous where the sewers were known to be foul.

Capt. Douglas Galton (London) believed Leicester was almost the

first town to attempt on a large scale to prevent the pollution of their river by the adoption of a chemical system, although the chemical system had not been quite successful. Of course the main advantage of any system of drainage was the lowering of the death-rate, and yet it would be seen from the statistics in Mr. Gordon's paper that except in one or two cases there was no such diminution in spite of the expensive works constructed. What was the reason of it? It was probably because the house drainage had not been considered at the same time as the sewerage of the streets, and treated as an integral part of town drainage. Until there was a thorough combination between the house drainage and the main sewerage they could never overcome all difficulties. He had never seen a town in England in which he should have been willing to have his house-drain connected with the main sewer for the purposes of ventilation.

Prof. de CHAUMONT, M.D., F.R.S. (Southampton), thought Captain Galton had somewhat underrated the diminution in the death-rate in the continental towns mentioned by Mr. Gordon, for in some of them there was a very decided fall. But the difference would be much better appreciated if the zymotic death-rate could be ascertained. There was one thing, however, that must not be lost sight of in this very important question, and that was, that although a town was sewered, the dangers arising from the fœcal matters were not touched at all. For instance, the city of Paris had a magnificent system of sewers, but, out of a population of 2¼ millions, there were not more than 30,000 or 40,000 persons whose excreta went into those sewers. The great difference between the health of the English towns and the health of the Continent was the increase of zymotic diseases in the latter. Although in this country we had, unfortunately, had a large increase of diphtheria in recent years the increase was really nothing when compared with the Continent. The amount of typhoid fever, too, on the Continent was inordinately excessive, and he thought it was impossible not to connect that with the fact that the excreta were not dealt with at all. If continental towns were not prepared to have a separate system for carrying off the excreta, they had better turn everything into the sewers, and depend on ventilation, with a proper disconnection of the house-closets.

Mr. ROGERS FIELD, M.Inst.C.E. (London), observed that there was something very attractive in the suggestion that the sewers should be ventilated through the soil pipes, as this would get over many difficulties with reference to sewer ventilation, but the cases were few and exceptional in which the plan could be safely adopted. Two conditions were absolutely essential for the safe adoption of this plan, viz., a perfect system of public sewerage, combined with a perfect system of house drainage. There were hardly any towns, and, as far as he knew, none in England, where those conditions could be found. Probably they existed in Frankfort, and also in Memphis, U.S.A. As to Frankfort, the public sewers are acknowledged to be

some of the most perfect in the world, and he could speak of his own knowledge as to the exceedingly complete character of the plans and regulations for the house drainage, having studied them very carefully when he was drawing up the bye-laws for house drainage at Uppingham, nearly ten years ago; in fact, at that time (before the Model Bye-laws of the Local Government Board were issued) he found that the Frankfort regulations were the only complete ones he could meet with.

With reference to Memphis, it might be remembered that a Paper was read at the Congress at Exeter in 1880, by Col. G. E. Waring, the engineer who designed and carried out the work, describing the thorough way in which the sewerage was executed, and the stringent regulations enforced with reference to the house drainage.

He could not agree with Mr. Hobrecht as to the advantage of having flat gradients for the sewers. His experience was that the better the gradient the less chance there was of accumulations of foul matter and generation of foul gases.

Mr. Ellice-Clark (Hove) urged that the Institute should endeavour to obtain translations of such valuable reports as had been alluded to by Mr. Gordon. In sanitary, as in in other matters, we were too apt to allow our insular prejudices to overcome our better judgments, which taught us to obtain good information from whatever quarter it came. There were many discussable points raised by Mr. Gordon's paper, but he should confine himself to the question of the system adopted for the ventilation of sewers at Frankfort. The method of making each soil pipe do duty as a ventilation for the sewer was the antithises of the system of ventilation adopted in this country, where sewers were ventilated in the street, independently of any method of ventilating house drains. The English system was not perfect, but there could be no doubt of its efficiency, which had been proved by many thousands of observations made in the sewers, to determine the velocity of the currents, the temperature and humidity, and the chemical constituents of the sewer air; he had himself spent much time in sewers of all sizes, and was satisfied that with ventilators at distances approximating 300 feet apart, *certeris paribus*, no dangerous sewer gases were formed; for instance he had hung two burnished electro-plated soup ladles, one in a room where coal gas was lighted every night, and one in a sewer where the ventilators were placed 200 feet apart, the former ladle became tarnished in 60 hours, the latter was a week before it was tarnished. Yet at times, with a rapidly falling barometer and a rising dew point, complaints were made of the smells arising from the open ventilators of this sewer. He endeavoured by increasing the number of openings and by flushing to keep the sewer air down to a temperature of 52° Far. Although it had been stated that the Frankfort sewer ventilation by shafts was a success, it would have been more satisfactory if observations such as he had alluded to had been made. Nothing was easier for the Borough Engineer than to stop up street gratings and place small vertical shafts in lieu thereof, and imagine because there were no

smells that the sewers were ventilated, but until comparative observations had been made and it had been demonstrated that a lower or as low a temperature and decreased humidity of the air were obtained by shaft ventilation, he should continue to believe that the open street gratings, with all their unpopularity, best accomplished the object in view. He might state that at Hove in 28 miles of sewers, each sewer was flushed with fresh water twice a week; of course many of the main trunk sewers were necessarily flushed much oftener. Sewage water was never used for this purpose, but always fresh water. Sewage water headed up, might carry away deposit by increasing the velocity of the stream, but it failed to lower the temperature or absorb the more soluble and dangerous gases, both of which necessary objects were accomplished by fresh water; the price paid was 5d. per 1,000 gallons, and two men were equal to flushing the 28 miles of sewers twice in six days. Notwithstanding this, he was frequently having complaints and was compelled in a few instances of narrow streets to substitute shafts of about 30 superficial inches for open gratings; he had made many observations in the shafts and found that the direction of the wind determined the direction of the air currents in the sewer, whether the shafts were all long legs, or long legs and short legs, which were popularly, but erroneously, supposed to create an air current down the short leg and up the long leg. The question was one of increasing interest; it would not be satisfactorily determined until Engineers made careful observations, and accurately recorded them, on the different systems, such observations to be extended over a comparatively long period and in different towns.

Dr. Paulson (Loughborough) feared that ill results would follow the adoption by Leicester of the proposed sewage system, and suggested that plots of land should be purchased, willow poles planted, and the sewage turned amongst them. He condemned ventilation by soil pipes and recommended and suggested a system of ventilation by the medium of the street lamp standards with a charcoal arrangement for deodorization—the sewer gas being forcibly expelled and disinfected, and the charcoal being perpetually renewed by the heat of the gas flame.

Mr. A. M. Fowler (Leeds) pointed out that there had been no improvement in the ventilation of main sewers during the last 27 years. In the house drains and branches, however, great progress had been made in this respect. If Leicester adopted a main system of sewerage, let them be careful to confine all the scavenging to one end of the town.

Mr. Everard (Leicester) briefly replied on behalf of Mr. Underwood, confining his remarks principally to a vindication of Mr. Wicksteed.

Referring to the proposed scheme for dealing with the Leicester sewage he expressed an opinion that the best place for utilizing the sewage was on a large tract of open land below the village of Quorndon, but considered that the Corporation were now committed to Beaumont Leys.

Mr. J. GORDON, M.INST.C.E. (Leicester), said that he felt gratified at the character of the dicussion. With regard to Leicester and its sewage scheme, he did not propose to enter into the merits or demerits of the scheme before the Corporation of Leicester. He thought the case of Leicester was unique in the question of sewerage, and there had been no end of reports on that subject. Only recently the Corporation instructed him to look into the question, and they had no fewer than ten schemes before them, out of which two were finally selected for discussion. Of those the Government Inspector had a predilection for the scheme which was now being adopted by the Corporation, and the Council therefore thought themselves justified in going forward with that scheme. It was well known that he favoured another scheme, which he thought had, notwithstanding various difficulties in connection with it, some advantages over the one adopted. There were, however, great advantages in the scheme proposed as against the great height to which the sewage was to be pumped; but he thought they would not be able to pump all the rainfall up to 175 feet. An inch of rainfall for 24 hours over the drainage area meant about 29,000,000 gallons of water, in addition to 8,000,000 gallons of sewage. It would, therefore, be quite clear that it was perfectly absurd to think of pumping any considerable portion up on to the clay land they had selected, and also on technical grounds it was very inadvisable to do so. The irrigation works in Berlin were not sufficiently advanced when he was there for him to see all that would be done. The chief produce at that time was vegetables and rye-grass. There was a great deal of prejudice against the vegetables at first, but they had since been reported as satisfactory. He was not prepared to defend the ventilation of sewers by soil pipes, except under such conditions as he had described. The apparent increase of the death-rate of Frankfort, to which Capt. Galton had referred, was due to peculiar circumstances. Formerly the people of Frankfort, and more especially the working-classes, were under considerable disadvantages in regard to the marriage laws, having to show that they were in a position to maintain a household before they were allowed to marry. The consequence was a great many migrated outside of the town for the purpose of marrying. When the Prussians annexed Frankfort they opened the gates to all and made it a purely free city. An entirely different class of people at once entered it, causing so large an increase of population that the death-rate, especially among children, was at once affected. Then again the large suburb of Bornheim was incorporated in 1877, the death rate of which was 38·1 per 1000 in 1879. Such a high death-rate naturally affected prejudicially that of the city, until the remedial works could be extended to the suburb in question.

With regard to Capt. Galton's remarks as to rates of mortality given in columns 28 and 29 of the table attached to his paper, shewing practically no advantage accruing from the works of sewerage, that gentleman cannot possibly have examined the tables at all carefully, for there are only two cases—namely, those of Chemnitz and Frankfort-on-the-Main—where the mortality does not show an im-

provement. That of Frankfort I have dealt with, and that of Chemnitz is accounted for by a very severe epidemic of small-pox during the period referred to, whilst on the other hand, the following cities and towns shew the following reductions:—

Berlin.....	2·73,	or from	31·73 to 29·00	per thousand.
Bochum	3·52,	„	34·41 to 30·89	„
Dantzic	7·85,	„	36·51 to 28·66	„
Dortmund ..	6·72,	„	34·37 to 27·65	„
Erfurt.....	5·19,	„	29·39 to 24·20	„
Halle	5·00,	„	30·00 to 25·00	„
Heidelberg ..	3·86,	„	27·04 to 23·18	„
Linz	10·17,	„	42·9 to 32·73	„
Mayence....	3·10,	„	29·8 to 26·7	„
Munich	5·50,	„	36·9 to 31·4	„
Paris	5·47,	„	29·75 to 24·28	„
Wiesbaden ..	6·00,	„	28·00 to 22·00	„

As to coping with rainfalls he remarked that in a district in Leicester in which the rainfall had been most completely separated from the sewage he found that still no less than 50 to 60 per cent. found its way into the deep sewers. It was quite true that a great deal of dissatisfaction was felt with open ventilators in cases, such as Leicester, where they had to deal with an old system of sewers. A large number of sewers with which they now had to deal were put in by private owners in a very defective manner. Many of them had consequently become sewers of deposit. They could not expect open ventilators to be so satisfactory under these circumstances as in such cases as he had alluded to as prevailing on the Continent, but he had yet to learn which was the better plan, whether they should keep the sewers hermetically sealed like gas retorts and allow the sewer gas to penetrate the interior of the houses, or put up with some little inconvenience by allowing the sewer gas to escape in the centre of the roadways.

On "Circular Hospital Wards," by H. Saxon Snell, F.R.I.B.A.

The proposition for constructing hospital sick wards upon what is known as the "Circular System," was first made in this country during the latter part of 1878, about the same time that the foundation stone was being laid in Belgium of a hospital intended to be built upon this principle.

The design for this building, the Antwerp Civil Hospital, having received the approval of the Communal Administration of the town, was referred to the consideration of the Council of Public

Hygiene at Brussels, but this body strongly condemned the erection of circular wards upon grounds which, now the building is erected, would appear to have been correct. Nevertheless, the work was proceeded with and the building is now opened and may be inspected by those interested in the question.

No other continental nation has, to my knowledge, considered this new system worthy of imitation, but in England, many similar hospitals have been erected, and it is, I believe, in contemplation to erect others.

There is something very fascinating about the conception of a circular ward, and superficial consideration of the question would lead to a belief in the soundness of the arguments advanced in favour of the system; indeed, I was myself disposed, before critically examining the matter, to allow that its adoption might possibly be productive of some if not all the benefits promised by its advocates. This illusion was, however, dispelled when lately I had occasion to study the question in all its aspects for the purposes of a report to a public body prepared to erect this class of wards upon my recommendation, and I propose now to show the reasons that led me to the conclusion that parallelogram shaped sick wards are in every respect much more economical both in first cost and in management, and that no advantage is to be attained by the increased outlay consequent upon the erection of wards of circular shape.

My present remarks will be confined to a consideration of the erection of wards for general hospitals, and I do not propose in this paper to deal with the question in its application to fever or other wards for special cases. Nevertheless I am equally convinced that the circular system as now advocated is wrong in any kind of hospital building whatever be its special use or locality; but to deal with the question in its application to other than ordinary hospitals would involve considerations which the time at my disposal on this occasion will not allow of being entered into.

It will be well to first consider what are the conditions necessary to be observed in the planning and construction of general hospital wards.

First as to the number of patients. I have the authority of Miss Nightingale and of many hospital superintendents, for stating it to be essential that besides the ordinary nurses and attendants every ward should have the constant presence of one head nurse in the day time and of one nurse at night time, and that these head and night nurses could each properly overlook forty patients as a maximum; but taking into consideration all the essentials for proper discipline and facility of administration, the number of patients in any one ward should not exceed

thirty-two or be less than twenty; also, that in all cases one or at most two separation wards, each for the accommodation of one or at most two patients, should be attached to the large ward, but not so as to communicate with it directly. All the wards should, however, adjoin the rooms occupied by the nurse having charge of the patients contained in them.

Except in the case of separation wards, wards of small size are decidedly objectionable, because they are (says Miss Nightingale), "unfavourable to discipline, inasmuch as a small number, when placed together in the same ward, more readily associate together for any breach of discipline than a larger number." * And it is also pointed out by her that one head nurse, or one night nurse, could not so efficiently superintend and overlook a number of small wards as one large one.

Each large sick ward, whether it contains ten or thirty patients, must have attached to it at least two w.c.'s and a slop sink, separated by cross ventilated lobbies. A bath room should also adjoin each large ward. It is therefore clear that the fewer the patients in each ward the larger will be the total number of nurses required in the establishment, and the greater will be the multiplicity of nurses' rooms, water-closets, slop sinks, bath rooms, and other sanitary offices.

Suppose a hospital, to be designed for the reception of 576 patients, 540 of whom are to be placed in eighteen parallelogram-shaped wards containing thirty each, and the remaining thirty-six in smaller and adjoining separation wards. If the buildings are three stories in height there would be six pavilions, but if, as I shall show, twenty-two patients only can be placed in the large wards because they are of circular shape, then eight pavilions would be required instead of six, and twenty-four wards instead of eighteen. In both cases these wards and pavilions are assumed to be of the same size.

It has been shown that the services of one head and one night nurse must be provided for each large ward, and it therefore follows that the adoption of this circular plan would involve the additional cost of twelve nurses for the six extra wards.

The two extra pavilions containing these six wards would also necessitate the additional services of one scrubber and one porter for carrying coals and meals and attending the fires, furnaces, &c., and the salaries, uniforms and maintenance of these 14 additional officers cannot be put at less on the average than £50 a year each, or a total of £700.

The additional cost of fuel for the warming and hot water supply to these two extra pavilions may be put at a minimum

* Notes on Hospitals, by Florence Nightingale, 1863.

sum of £200 per annum, and the outlay for soap, soda, &c., for cleaning and the periodical whitewashing, painting, and repair cannot be put at a less sum than £100 per annum. Therefore the total additional establishment charges consequent upon the adoption of the circular system would be £1,000, as follows, viz.:—

12 extra Nurses 1 „ Scrubber 1 „ Porter	at £50 per annum each ...	700	0	0
Extra Fuel		200	0	0
Soap, soda, &c. and repairs		100	0	0
	Total	£1,000	0	0

This sum capitalised at 3 per cent. (33 years' purchase) would amount to £33,000 and this represents the additional cost of maintaining the 576 patients supposed to be housed in wards designed upon the circular system.

The additional cost per 1,000 patients would be £57,392 and this cannot be considered a large estimate seeing that Miss Nightingale in her work on hospitals shews that where 9 patients only are contained in a ward as against 32 patients in a ward the additional capitalized outlay for nursing only would be £196,775.

Now as to the relative cost of erecting the buildings—a question involving primarily a consideration of the requisite sizes for the wards.

There must be much diversity of opinion amongst medical men and other authorities upon this point if we are to judge from the dimensions of recently constructed hospitals.

Capt. Douglas Galton considers that between 1,200 and 1,300 cubic feet of air space per bed is all-sufficient. Miss Florence Nightingale asks for from 1,200 to 1,500 feet. Dr. Parkes speaking of hospitals generally, says that the space should be from 1,500 to 2,000 feet (the latter quantity referring no doubt to fever and the former to general hospitals). Dr. de Chaumont in his Report upon the Norfolk and Norwich hospitals, shews upon mathematical bases that where good ventilation exists no advantage is gained by making the air space of large wards greater than 1,200 feet per patient.

The report of the committee appointed to consider the cubic space of metropolitan workhouses and infirmaries states that the cubic space to be allotted to ordinary sick patients in large wards "should not be less than 850 feet;" but it is stipulated that no space above the height of 12 feet from the floor-line

shall be included in the calculation. This committee consisted of the following eminent authorities, viz., Drs. Thomas Watson (chairman), Henry W. Acland, Francis Sibson, W. O. Markham, and John Randall, Capt. Douglas Galton, Messrs. Uredale Corbett (Local Government Board Inspector), Timothy Holmes, F.R.C.S., and Charles Hawkins, F.R.C.S.

In my own practice, I have erected four large parish infirmaries, holding in the aggregate upwards of 2,500 ordinary sick patients, with less than 950 cubic feet of space to each, and the medical officers of these establishments have not found it necessary at any time to order the removal of any of the beds, as was contemplated, should one or more extraordinarily severe cases at any time be developed, and seem to call for increased space.

The Moabite Hospital at Berlin gives a space of only 864 cubic feet for each ordinary patient; but in this building one-fourth of the cases treated are stated to be of an acutely infectious character,* and we may presume that a larger space would be allotted for this class of patient. Yet the death rate at this establishment, I am assured by eminent men who have examined the returns, is not above the average of other German hospitals.

The proper size of hospital wards is not however to be determined by mere considerations of the greater or less quantity of air-space requisite for the well-being of a patient, for Prof. de Chaumont in his report before referred to, has clearly shown that where by good ventilation a proper change of atmosphere is constantly effected, it matters not within reasonable limits what is the size of the ward. The question must be decided principally by consideration of floor space, and here again examples and opinions are sadly diverse.

The Moabite Hospital, and the four parish infirmaries previously alluded to, contain about 70 superficial feet of floor space per ordinary patient, and this is the quantity recommended by the before-mentioned committee of experts.

Capt. Douglas Galton asks for from 90 to 112 feet, Miss Nightingale from 100 to 104 feet, and Dr. Parkes and Prof. de Chaumont, from 100 to 120 feet. In each case these authorities seem to determine their maximum and minimum by the question of whether or no accommodation is to be provided around the bed for students, *i.e.*, whether the hospital is or is not to be designed for a medical school.

The disposition of the superficial space determined upon, whatever it may be, involves two important questions, viz.: the

* Hospital Construction and Management, London, 1883.

width of the ward, and the distance apart of the beds. Twenty-four feet is conceded to be for all purposes of administration an all-sufficient width for any hospital ward, and inasmuch as it is of the highest importance that each bed should have the largest possible space surrounding it, this width would, I apprehend, never be exceeded, were it not for the desirability of reducing the length of a ward to within a limit not exceeding 120 feet.

In parish infirmaries the prescribed distance apart of the beds, *i.e.*, the bed space, is 6ft.; but 7ft. 6in. or 8ft. is the width more generally adopted, and hence it comes about that the breadth of the wards is necessarily increased in some buildings to as much as 30 feet. And here I would point out that the advocates of the circular ward system invariably and wrongly use the term "wall space" as synonymous with "bed space," or the distance apart from centre to centre of the beds; and they often improperly calculate this distance apart of the beds by dividing the total length of the circumference of the circle by the number of beds, and so arrive at a deceptive result.

Take, for example, the description given in *The Builder*, of May 9th last, of "A projected Military Hospital" designed upon the circular system. It is there stated that the wards are each to be 66ft. internal diameter, and that they are to hold 26 patients: thus (says the description) "each patient will have a wall space of 8ft."

As a matter of fact, if this military hospital is ever erected, and 26 patients crowded into its wards, each will have a lineal wall space at the heads of their beds of 7ft. 4 in., but the corresponding distance at the bottom of the beds will be but 6ft. 3in.; that is to say (the beds being 3ft. wide) the distance apart of them will be 3ft. 3in. only. And, therefore, if it is required to know what really will be the space given per bed in this proposed hospital, as compared with the quadrangular plan of ward, we must calculate the average distances apart as given above of the beds at the heads and at the feet, and then, instead of the delusive 8ft. of wall space, we shall find that the actual *bed space* per patient in this proposed hospital would only be 6ft. 9½in.

The above results would be arrived at by deducting 6 feet 6 inches in width for each of the entrance lobbies, and then planning out the feet of the beds at an equal distance apart, and radiating them towards the centre of the circle.

Then with regard to the height of hospital wards. It is only Professor de Chaumont who expresses any decided opinion upon this point, and the conclusion he arrived at that 12 or at most

13 feet is all sufficient, has since been confirmed by the results of experiments made by two eminent American physicians, Drs. Cowles and Wood,* who proved to their satisfaction that no benefit arises from making wards higher than 12 feet. It is also no doubt upon these conclusions that the recommendations of the cubic space committee before referred to were based.

Most other authorities regard the question of height as quite subsidiary to that of floor space, as decided by considering the width of the ward, and the distance apart from centre to centre of the beds.

I have been particular to cite the opinions of these great authorities as to the requisite dimensions of ordinary wards, because I am about to show that it is practically impossible to design a circular hospital ward within the limits they have laid down, without causing a useless multiplication of wards, ward offices, nurses and domestics, resulting in an enormous and wasteful outlay, first in the erection of the buildings, and for all time in the annual establishment charges; and my argument would therefore admit of contention if it could be shown that in the illustration I am about to give, I exceeded these limits, for it will be seen hereafter that the smaller we take the units of space the greater will be the cost of the circular, as compared with the parallelogram-shaped ward; and I therefore propose to take for illustration a ward of dimensions which shall approach, as nearly as possible, the maximum quantities asked for by the before-mentioned experts.

A parallelogram-shaped ward (see fig. 2, page 217), containing 30 beds, and being 28ft. wide, 120ft. long, and 14ft. high, will contain 1,568 cubic feet, and 112ft. of floor area per patient, whilst the bed space will be 8 lineal feet per patient.

A circular ward (see fig. 1, page 216) of equal superficial floor space would be 65ft. 6in. diameter, and if it is required (as for proper comparison it must be) to keep the beds the same distance apart as in the parallelogram shaped ward, this space would not contain so many even as 22 beds. For if we consider the feet of the beds to be 7ft. distant from the outer wall (6ft. 6in. for the length of a bed and 6in. space between it and the wall), and the width of the two lobbies as 13ft., we find that if there are 22 beds, the lateral distance from centre to centre of the feet of each is 6ft. 9in., and the corresponding distance between the heads 8ft. 8in., thus giving an average distance of 7ft. 8in. only as against the 8ft. space of the parallelogram shaped ward. The result is that by the adoption of this circular plan we should have a ward containing less bed space

* Report of State Board of Health of Massachussetts, 1879.

and in round numbers respectively 41 superficial and 571 cubic feet per bed more than we started by admitting was necessary for the healthy condition of the patients.

The dotted line upon the plan (Fig. 2) encloses the central space thus wasted in each ward, amounting respectively to 896 superficial and 12,553 cubic feet.

Various ingenious suggestions have been made for the disposal of part of this space. One proposes to erect a staircase which, according to his plan, would occupy 250 superficial feet out of the 896, and at the Antwerp Hospital, a still less quantity is enclosed to form a room (ostensibly, but never, I believe, in reality) for the use of a nurse. But besides the practical inutility of adopting these expedients, it will be seen that any such obstruction would only augment the difficulties of cross ventilation already created by the necessity of having the windows between 60 and 70 feet apart.

What then is to be done with this superfluous space? It has to be built, to be kept clean, to be ventilated, to be heated, but worst of all it has to be paid for; and at what cost I will now consider.

The two additional pavilions previously shown to be necessary would cost, including heating, lifts and fittings, £26,800, and the outlay for the additional accommodation of twelve nurses, including furniture and accessories, would amount to about £700, or together to £27,500. It will be observed that I have not taken into account the fact that the six remaining wards being built upon the circular system must of necessity be of more costly construction than if they were built up on the parallelogram principle.

This sum of £27,500 represents the additional cost for 576 beds, and is at the rate of £47,743 per 1,000 patients. Adding to this the capitalized cost of nursing these 1,000 patients, previously shown to amount to £57,392, we find that if the circular system is to come into vogue, we must be prepared for indulgence in the luxury (if it is one) at the rate of £105,135 for every 1,000 patients.

Should it suggest itself to any one to enquire how a circular would compare with a parallelogram shaped ward if both were designed to contain 30 beds, an average distance of 8ft. apart, it would be found that the circular ward must be 87ft. 9in. diameter, and consequently the waste or unnecessary space in the centre of it would amount to no less than 2,705 superficial feet. Moreover, it would be evident that the height of such a ward must be raised considerably if any sunlight at all is to approach the centre of it, and supposing this additional height to be, say 3ft., the quantity of waste or unnecessary space in one ward alone would amount to 64,180 cubic feet. But this

is not all, for it would follow that the adjoining offices, separation wards, nurses' room, staircase, &c., must also be raised.

It will hardly be neceesary I think to trouble you with the figures which would show the additional cost of this plan to be even greater than has been proved to result from a comparison of two wards of equal area, but with fewer beds in the one of circular shape. Neither need I point out to you how much all the other difficulties of ventilation, lighting, heating, and want of cheerfulness would be enhanced.

Advocates of the system however say, "we have nothing to do with the cost; what we desire is to erect that description of building, whatever it may be, which best adapts itself to the cure of the patients to be contained in it," and within reasonable limits this view of the question is no doubt a right one.

But I have searched in vain for any substantial arguments shewing that from this point of view the circular is any improvement upon the parallelogram shape of ward, and I have little doubt that no such arguments could exist unless it can be shewn that in contravention of nature's laws air would as freely pass through a room from one side to another when the windows are 60 or 70ft. apart, as it would if those windows were from 24 to 30ft. apart. It would also have to be demonstrated that in defiance of all mathematical rules, when the sun was shining or the wind blowing against the straight wall of a parallelogram shaped ward, less air and sun would penetrate through its window openings than would penetrate an *equal* number of window openings of the same size contained in the wall of a circular ward. And then, having proved this anomaly, it would be necessary to define the process by which as large a quantity of air and sun could be brought into the circular ward through its 22 windows as could be brought in through the 34 windows of the parallelogram shaped ward.

This being made evident the contention must be upheld that a ward having the distance of its parts from the windows varying from 1ft. to 33ft., is as cheerful as one the parts of which vary similarly from 1ft. to 14ft. only. And it must be shewn that this cheerfulness will not be diminished by the height of the circular ward being $\frac{1}{5}$th only of its diameter as compared with the parallelogram shaped ward, the height of which would be one-half its width.

But supposing all these difficulties to be surmounted, it will only have been shown that in the points referred to the circular is as good as the parallelogram system, and then what is left to compensate for the £105,000 outlay before referred to?

It cannot be contended that for the purposes of a medical school, where it is desirable the greatest space for students shall

be given round and about the patient, that the constriction of the feet of the beds, consequent upon their radiation towards the centre of the circle, is an advantage. It cannot surely be argued that it is a desirable arrangement to place a nurse (as at the Antwerp Hospital) in the centre of a sick ward, breathing all day its more or less foul atmosphere, rather than that she should be assigned an adjoining room, having a window through which she could overlook the patients. Neither can it be said that if this central space is occupied by a staircase, that such staircase would not be better placed (as in the parallelogram system) away from the ward and adjoining and giving direct access to the nurses' rooms, separation wards, and other offices, and so avoiding the necessity of all persons and things passing through and disturbing the occupants of the large ward.

And if, then, these deviations from past practice cannot be shewn to be improvements, what is left for those who would still be admirers of the new system to put forward as a claim for its superiority over the old one? I cannot say, neither can I imagine.

Capt. GALTON, C.B., F.R.S. (London) said he also had been struck with the radiation of the beds in the Antwerp hospital. The central room for the nurse was an impediment both to the cheerfulness of the ward and the free circulation of the air, besides being an utterly useless place for anyone to live in permanently. The building was designed to be very largely artificially ventilated, but unfortunately the apparatus was not at work when he was there. He had had similar experience elsewhere, and although he had often wanted to examine the arrangements in artificially-ventilated hospitals, it had always happened that they were not in working order. He agreed entirely with the arguments which Mr. Snell had adduced, and wished the various hospital authorities contemplating the construction of circular hospitals would read his paper.

Prof. DE CHAUMONT, M.D., F.R.S. (Southampton), said he was at first attracted by the circular design, but he confessed the objections of Mr. Snell were very difficult to answer. The Antwerp hospital was by no means attractive in appearance, and to place a nurse in the cage in the centre would be simply monstrous. The adoption of this system would, he feared, not answer the expectations of its promoters. Yet the matter was one of great importance, seeing that it was now strongly advocated by the Director of Works at the War Office, and the proposal to build a hospital on this principle at Malta was now seriously entertained. He would take care that Mr. Snell's paper was brought before the notice of the War Office.

Mr. H. H. COLLINS (London) agreed with the views expressed by Mr. Snell. Circular hospitals were undesirable if on the score of

expense alone. To construct a circular building was at least a third more costly than to build a parallelogram. At the same time, he admitted there might be some excuse for building a circular hospital in the case of a site which would ill adapt itself to any other form of construction.

Mr. E. C. Robins (London) thanked Mr. Snell for his paper, and was glad to know it would come under the notice of the War Office. He looked forward to the time when tents that could be taken down and destroyed when their purpose was fulfilled would supersede colossal hospitals, or better still, removable buildings on the Tollêt system. He felt he must concur with the views expressed by Mr. Snell, confirmed as they were by such high authorities as Professor de Chaumont and Captain Galton. He must confess, however, that he was much taken with the Antwerp Hospital on seeing it during its construction, and he thought it unwise to condemn beforehand the heating and ventilating processes so intelligently and scientifically designed and executed.

Mr. Gordon Smith (London) said he could not concur in all that had been said. He feared Mr. Snell had somewhat exaggerated his case, in addition to which there were some features about the circular ward system that demanded more attention than had been paid to them. For instance, the question of shape of site was of great importance. It was quite possible to have a site (upon which a hospital must be built) that would adapt itself to a circular building far better than to a rectangular one. A circular ward would stand less chance of interfering with a neighbour's rights of light and air, and would admit of freer ventilation. In aspect also, a circular building had advantages over an oblong one, while in regard to cost he had it on the authority of two architects who had actually built circular hospitals, that in some respects this form of building was really cheaper. He also urged that the circular ward afforded advantages in administration in the way of facilitating control and minimising fatigue which were not possessed by the rectangular or oblong ward, and he considered the circular form of ward, notwithstanding what had been said against it, deserved careful attention.

Mr. H. Saxon Snell (London) in the course of his reply, contended that no hospital ought to be erected upon a site so confined in area that rights of light and air had to be considered; and he did not hesitate to say that wherever, upon this plea, circular wards had been built, rectangular ones would have answered the purpose far better. He failed to see how circular wards could give greater facilities for ventilation than those of rectangular form. In the latter the foul emanations from the patients were removed by outlets into flues situated in the walls directly over the patients' heads. Surely this was a better plan than carrying the deleterious matter across the ward, a distance of 30 to 35 feet, into the central shaft, as recommended by the advocates of the circular system.

PLAN OF A CIRCULAR-SHAPED HOSPITAL WARD OF EQUAL AREA TO FIG. 2.

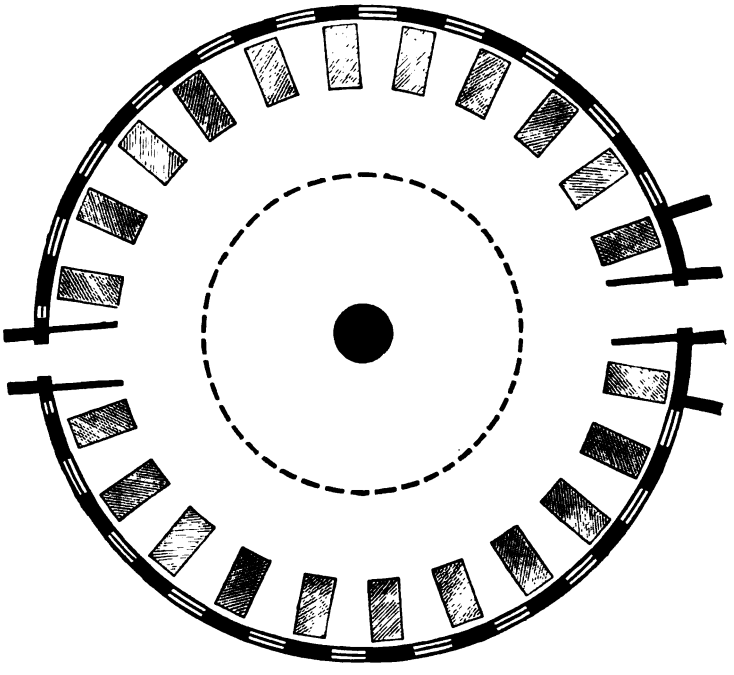


FIG. 1.

Dimensions—

65 feet 6 inches diameter.
206 feet circumference.
7 feet 8 inches average distance from centre to centre of beds.

Contains 22 beds. Scale 22 feet to an inch.

PLAN OF A PARALLELOGRAM-SHAPED HOSPITAL WARD OF EQUAL AREA TO FIG. 1.

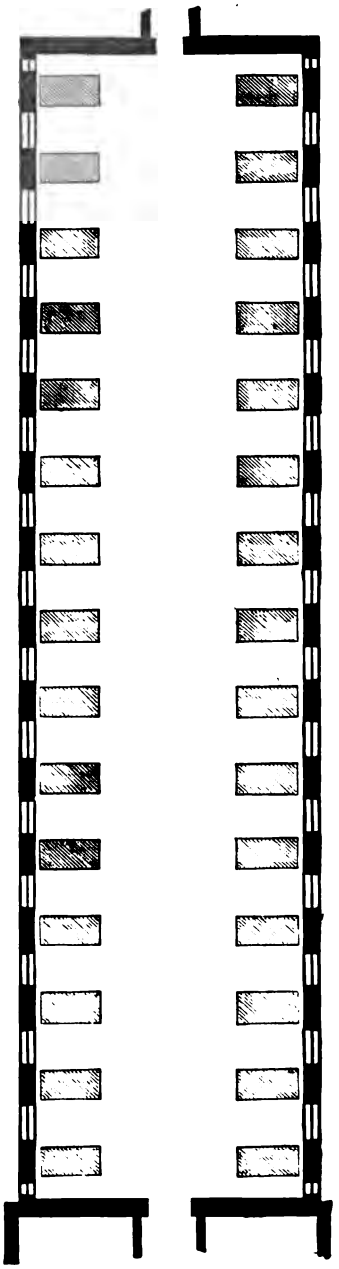


Fig. 2.

Dimensions—
120 feet long.
28 feet wide.
8 feet from centre to centre of beds.

Contains 30 beds.

Scale 20 feet to an inch.

On "Smoke Abatement," by W. R. E. Coles.

That smoke should be prevented is now, to a large extent, admitted. But the *reasons* why it should be so have yet to be far more clearly and widely apprehended by the public at large, if the Sanitary Institute of Great Britain is to indulge any reasonable hope of ultimate success in that department of its work which relates to the purification of town atmosphere. I purpose to refer very briefly to these reasons, and to submit a few observations upon the subject, my remarks being based upon the result of the painstaking enquiries and serious reflections of many persons who have given special and earnest attention to the matter.

1. *The health aspect of the question.*—It cannot be too widely known that the death-rate of towns is considerably increased by the smoky condition of the atmosphere. Diseases of the respiratory organs and diseases of the zymotic class are alike more deadly in those towns which are most smoky. The evidence which has been collected in relation to the health aspect of the smoke question is very ample, and in a very notable degree it is free from conflict of opinion. The opinion of the medical profession has been expressed strongly and unanimously against smoke. Physiologists, too, have been consulted, and they have carefully determined, and clearly explained, the injurious operations of a smoky atmosphere upon animal life. Not only have health records supplied statistical proof of the fact that in smoky districts the duration of life is shortened and health is deteriorated, but scientific investigations have done much to explain the precise *causes* of these injurious effects of coal smoke. Among these causes may be mentioned one that is often overlooked, viz., that light is obscured by the smoke-cloud, and thus we are deprived of one of the most essential elements of animal life. It has been said by one of the most eminent physiologists that sunlight is almost as important to us as the food we eat. It may be, perhaps, well to mention that a few of that injurious class of persons, whose little knowledge is a dangerous thing alike to themselves and to those who receive and disseminate their statements without any reflection or the least inquiry into the truth or falsehood of what they hear, have said, and have actually written letters to the newspapers to urge that there is "a plea for smoke in town atmosphere," on the ground of its being antiseptic, or, in other words, that

smoke has the quality of destroying the germs of disease. Now, so far as the most careful inquiry and reflection enable us to judge, there is not only no single tittle of evidence in support of this assertion, but, as I have shown, the whole of the most reliable evidence obtainable points in exactly the opposite direction, and proves that a smoky atmosphere is positively deadly in many cases, and is always more or less injurious to health. I may add, because I think it is very important to prevent baseless assertions passing current, that our present knowledge goes to prove unmistakeably that it would be physically impossible to destroy any of those minute organisms or "germs," as they are popularly called, which are supposed to produce or propagate certain diseases, without making an atmosphere in which it would be absolutely impossible for human beings to exist. In other words, we should be obliged, in order to kill the "germs," to kill the people! Thus it would appear that the assertion that smoke is valuable as an antiseptic is not only baseless but is absolutely foolish. The same class of persons who have put forward the notion that smoke is antiseptic, have also advanced the idea that smoke may be good because the carbon in it is a "deodorizer." This theory would appear to be almost equally foolish with the other, for though carbon in some states and in some quantities has deodorizing qualities, we could not endure an atmosphere so charged with it as to be deodorizing. And I believe we may take it as a fact that the deodorizing agency of the carbon in our densest smoke is practically "nil." Any persons who wish to study these questions closely will have no difficulty in finding abundant means of advancing their knowledge; but I would beg all to consider the matter broadly in the light of their ordinary common sense and common experience, and they will, I think, need no other evidence to convince them that they are not so well and vigorous in a smoke-polluted and darkened atmosphere as they are in pure air under an unobscured sky.

2. *The moral aspect.*—You will not be surprised to hear that those persons whose knowledge of the poorer classes of the community is greatest, and whose labours are directed to ameliorating their condition, are *very* urgent in their desire to see smoke abated. Intemperance follows as the almost natural consequence of lowered vitality and debased surroundings. To the poorer classes the subject of smoke abatement is one of even greater importance than to any. Their homes are for the most part in the least ventilated and most smoky districts. They are less able than other persons to get away to fresher air and cleaner surroundings. To them the expense and the labour of keeping themselves and their homes clean are things of vital consideration. To war successfully against dirt is

practically impossible for the poor while they have to live in an atmosphere of smoke. There is often but one poor pair of hands to do all the work, and those the overwrought ones of a sickly woman, whose first care must be to attend to the more immediate wants of her husband and her infant family. To the cotter's wife in the country it is hard enough to keep her house, herself, and her family clean. To the labourer's wife in one of our smoky towns, where everything is soon covered with smuts which fall so fast as to blacken the clothes even while the poor woman strives to dry them, it is practically but a mockery to tell her to be clean, and that she *ought* to keep her home and family decent. It is unnecessary to dwell on this theme. All who have considered the subject and know anything of the actual condition of the poorer classes will admit the great practical difficulties which stand in the way of their becoming more temperate, more cleanly, and more elevated in their habits while smoke-dirt abounds, and the smoke cloud obscures those rays from the sun which have the power of invigorating the moral as well as the physical life of man. It may be added that the smoky condition of town atmosphere is one of the chief causes of many persons living out of town, and thus necessarily withdrawing in a great degree their active sympathies and various social influences for good from their poorer brethren who are compelled to remain continually in town.

3. *The Economic Aspect.*—It has been proved in almost every department of enquiry that money loss is associated more or less directly with the systems of heating which are generally accompanied by the production of smoke. Here, again, I think the poorer classes personally suffer most acutely. The sheer exhaustion and inability to work which is often experienced by them is, I fully believe, in a great measure due to the enervating influences of smoky atmosphere. Therefore, to them it is a wage-earning question. The public pay in one form or another an enormous aggregate amount in connection with the production of visible smoke and the wasteful uses of coal, and all classes are compelled to bear a portion of the tax whether they themselves contribute to the evil or not. Beyond the large losses which follow *directly* from wasted fuel, wasted labour, the cost of conveying unnecessary quantities of material through the streets, and the cost of cleaning and renewing articles deteriorated by smoke, the *indirect* losses resulting from imperfect and inconvenient heating systems are known to be so serious as to demand the utmost attention of all classes, and induce a general review of heating methods.

The Improvement of Heating Methods.—In some degree a review of heating methods has already commenced throughout

the kingdom, and some substantial and beneficial changes have been made. In industrial as well as domestic heating processes the chief changes have been made in the direction of substituting gaseous fuel and coke for crude bituminous coal. Next to these changes it is observable that greater regard is generally paid to the character of the heating apparatus which is used, and especially to the avoidance of losses of heat by conduction, radiation, &c. Various methods of treating crude coal by processes of distillation in order to recover the volatile products which are ordinarily lost in the form of visible smoke, have been practically reviewed, and in some degree satisfactorily applied. The extended introduction of gas engines in substitution of steam engines is also noticeable. But *greatest* of *all* the changes is the enormous increase in the use of ordinary coal-gas for domestic heating and cooking purposes, particularly the latter. This change has been brought about by genuine public recognition of the vast convenience and other advantages which gas fires possess over ordinary coal fires. In fact, the advantages of the former are so marked and so many that wherever gas is obtainable at the relative price which ordinarily subsists between it and coal, and good stoves are to be procured, there is practically no room for comparison between the two systems. In fact, when we reflect for a moment that there is no labour involved in bringing gaseous fuel to the fire, or taking ashes, &c., away from it, and that the heat required can be obtained exactly at the time it is wanted, and that it can be dispensed with directly the work is accomplished by the mere operation of turning a tap, the question of superiority, so far as the convenience at any rate of gaseous fuel is concerned, is at once settled in its favour. The practical hindrances which formerly stood most in the way of gas being used for heating purposes were:—

1. The stoves obtainable were very imperfect, often failing from bad design or bad construction, and they were generally very difficult to keep clean. Moreover, they were very extravagant in the consumption of gas.

2. The expense of purchasing the stoves was prohibitory to many householders.

The first difficulty has virtually been removed by very great improvements having been made since the Smoke Abatement Committee commenced their organized efforts in the cause of smoke abatement in 1880, when practical trials of all kinds of heating appliances were made, and the results were made known among manufacturers and inventors. The second difficulty has been met, in a great degree, by the chief gas companies letting stoves on hire at very moderate charges. The price of gas having been reduced has also tended to increase its use.

The Sources of Smoke.—The smoke from industrial works has long been under a certain degree of legal restraint, but domestic chimneys, which in the aggregate generally produce the largest amount of smoke in our towns, are absolutely free to emit as much smoke as the occupiers choose. Therefore it is, I think, the more noticeable that it is now demonstrated that smoke from this source can be, and is being to some extent, prevented.

The chief reasons alleged for continuing smoke from domestic chimneys should be noticed, and they may be summarised as follows:

1. *The comfort of the open fire.*—This reason is a good deal shaken when people consider that there are a good many discomforts connected with the system, such as the warmth being unequally distributed, the operation of coaling being dirty and troublesome, chimneys requiring frequent sweeping, and their often smoking, &c.

2. *The advantage of ventilation derived from the open coal-fire.*—This reason also is considerably shaken by the recollection that instead of getting sufficient ventilation, we often get only draughts of cold air drawn direct to the fire-place.

3. *The expense of altering the existing stoves.*—This objection is untenable in the numerous cases where gas-stoves are available, from the fact before-mentioned, that they are to be procured on hire fitted ready for use; and they might advantageously be used for cooking purposes even though the existing system were maintained for warming living rooms.

4. *The impracticability of applying restraint.*—It is said to be impracticable to apply restriction of any kind to domestic fires, because the "Englishman's house is his castle." The fallacy of this objection is at once apparent when we remember that the restraints on domestic habits are already numerous, and in many instances they are far more onerous than those which would be necessary to check the evolution of smoke.

The prospect of abating smoke.—This lies, I think, in the hope of these several things:—

1. That the serious moral and material evils which are associated with a smoky atmosphere may become more widely recognized.

2. That it may become generally known that smoke is not a necessary concomitant of heating; that as a fact it may practically be prevented, and therefore it reasonably should be restrained in populous places, the operation of the law being extended gradually in the case of existing premises, and peremptorily in the case of new buildings.

3. That it may become popularly observed that our social

habits and industrial arts have reached such a position as absolutely to require more economical and more convenient heating methods than those now generally prevalent, and which, for the most part, unnecessarily produce smoke.

In conclusion, I would particularly urge that the observations I have put forward for your consideration may be interpreted in their broadest sense. I do not by any means seek to imply, as some do, that the prevention of smoke is quite easy, and that in every individual instance an immediate benefit is to be obtained by preventing it. On the contrary, I know that it frequently pays the individual best, and saves him a good deal of trouble to continue making smoke. But that does not, I submit, in one whit invalidate the general conclusion of the whole matter, which is that on every ground smoke, in towns especially, should be prevented by the action of an enlightened public opinion and the restraining power of the law. I believe that the advantages associated with smoke prevention are only to be obtained, like all other advantages are, by certain sacrifices; but I equally believe that those sacrifices in the case of smoke prevention would, in the main, be but very trifling in comparison with the immense gain which would result.

Mr. Percival Gordon Smith, F.R.I.B.A. (London). We have heard some interesting remarks about this troublesome subject which Mr. Coles has put before us in a moral as well as a sanitary aspect—both of extreme importance. I am glad to find that he has referred to the domestic chimney, because I have often thought that the domestic chimney is as fruitful a source of nuisance as the manufacturers' chimneys. The old size of 14 by 9 inches I have often heard architects say is not the best for creating a proper draught up the chimney, but a great many architects and others are not aware that it is the size laid down by Act of Parliament. There is an old Act of Parliament, the Chimney Sweepers' Act, passed nearly fifty years ago, which says that every chimney from a habitable room is to be at least 9 inches by 14, and curiously enough the police are the parties to see that this is carried out. I believe the police are altogether unaware of this part of their duty. It is often suggested that 9 by 9 would be a better size, and perhaps that point may be referred to presently. Some of our provincial towns are certainly great polluters of the atmosphere, and I have heard it said that Sheffield, which is one of the smokiest towns in the kingdom, is exempt from the Smoke Abatement Laws.

Mr. Ernest Hart (London) observed that Mr. Coles said very truly that all physiologists agreed that the first and principal result of smoke was to obscure the rays of the sun, and thus destroy its

influence; but if we substituted for that, that when the sun's rays are struck down by smoke, conifers die, flowers cannot be made to grow, wax cannot be bleached, every one would see at once how the influence of the sun, which was essential to the physiological processes of life, must influence inhabitants of cities, as it influences organic plants and animals which show more immediately the want of sunlight. When he was a boy, roses grew abundantly in Kensington Gardens, and his great delight was to go there and pluck them; but a rose could not be made to grow there now, and the last conifer in Kensington Gardens he believed died last year, and the last wax bleaching factory disappeared from Shepherd's Bush last year—all pointing to the lowering of human vitality by the smoke fall. As to the means of progress, a great deal depended upon voluntary co-operation of individuals, and a great deal upon the willingness of magistrates to enforce the law as it existed. As to manufacturing towns, according to their methods of government, which he did not think they were at all likely to alter, it was much the habit of taking care that legislation should not outstrip public opinion, and with that view the enforcement of penalties for the non-observance of the law was placed in the hands of gentlemen supposed to represent public opinion, and who would not enforce it more rigidly than public opinion would allow. Thus it was that in manufacturing towns laws existed which would prevent the smoke nuisance, but inasmuch as those who enforced the law were themselves producers of smoke, they interpreted public opinion to be in favour of the smoke which they produced, and as smoke inspectors were under the control of magistrates, who were probably leading manufacturers, it was difficult to see how the magistrates could err. Parliamentary smoke was defined as issuing from a chimney so densely that they could not see the sky through it. A man, however, saw more or less acutely according to the impressions which were passing through his brain, and a good many people could see the sky when everything was black and smoky. Unless they made laws more stringent, their only other power was the motor power of public opinion, and he thought they were disposed to rely upon that. He did not believe they could cure everything by putting into Acts of Parliament "must" or "shall" or "may." He did not think public opinion would bear that out, and his own experience was that the introduction of imperative words such as "shall" was apt to lead to a reaction, thus destroying the very objects they desired to meet. He was delighted to find that Mr. Coles, who felt it his duty to preach that crusade, had read that paper which he hoped would have its effect in that particular town, and that so far as the law went it would be enforced, and that individuals would use in their own houses that kind of fuel and those appliances which would most effectually prevent the unnecessary production of smoke. He should be quite rewarded for attending that morning by the information which the President had given, of the curious parliamentary regulation affecting the size of chimneys. It had evidently been laid down for another purpose altogether, and was one of those feudal relics that they would have to sweep away.

Prof. DE CHAUMONT, M.D., F.R.S. (Southampton), said he could corroborate what had been said about the alleged antiseptic effect of smoke. It was an idea that people ran away with, and in scientific circles the illusion was not dispelled. The experiments he had made, in conjunction with Prof. McDonald, showed that the amount of sulphurous acid in the air necessary to kill bacteria exposed to it, would have to be so large that no human being could possibly live in it. That would dismiss altogether the supposed antiseptic effect of smoke in the air. By putting against it the terrible counter effects of the absence of sun-light, he thought the indictment against smoke was complete. With regard to the changes made in the methods of the domestic consumption of fuel, one of the great difficulties with reference to the adoption of gas was the high price of the commodity in certain places, and he distinctly charged that against the gas companies. He knew places where the gas companies, after paying the maximum dividend, were putting to the reserve fund a larger sum than they paid in dividends. He did not think that ought to be allowed. The legislature stepped in and put a limit to the amount of dividend, but he thought it ought to be clearly laid down that gas companies, after getting the maximum amount of dividend, should apply the surplus funds to reducing the price of gas to the lowest point. Then the employment of gas would be adopted on account of its greater cleanliness and easier management. Some people objected to the smell in the house, but that was simply because the apparatus was imperfect, for the smell could easily be got rid of. There was also the desirability of providing fuel gas of a cheaper quality than the ordinary highly carburetted gas that they used for lighting. In the case of lighting gas there was a small quantity of heavy carburetted hydrogen for the purpose of incandescence, but they did not want that in the case of fuel. They wanted the maximum amount of heat and no deposit, and if gas companies could be induced to make inferior gas for heating purposes, they might give it them at a price which would be sufficient for all incomes. He was told that it could be made for 1/- per 1,000 feet, and even lower than that. Some of those improvements would no doubt bring the use of gas within the reach of all, and if they could add to that the introduction of domestic electric lighting, they would have arrived at a perfection which was certainly ideal. His first visit to Leicester had impressed him with the freedom from smoke of the atmosphere, which he was informed was attained by the quality of the coal which was consumed.

Mr. FRED. SCOTT (Manchester) thought there was a difficulty in adopting the suggestions of the last speaker. In Manchester they had done a great deal to get the authorities to put down the smoke nuisance; they had got severe penalties legalized, and they now had the power of inflicting a continuing penalty of £10 per day on any manufacturer who exceeded the limit of smoke production. The increased powers held by the Corporation were however in abeyance. As had been pointed out by Mr. Hart, it was useless to expect that inspectors would report offences created by persons upon

whose goodwill they were virtually dependent for employment. The Society with which he was connected had on several occasions employed independent inspectors, to show to what extent the official inspectors were failing in their duty, and they had proved that one man could, in a week, report as many breaches of the regulations as the town inspector had reported in a month. The result of the action of the Manchester and Salford Sanitary Association, in the first instance, was an immediate display of activity, the prosecutions for smoke offences increasing from three or four per week to many times that number; but as the requirements of the Corporation increased in stringency, all kinds of excuses were made, the familiar complaint of "interference with trade" doing good service in the interest of offenders. The inactivity of the authorities in enforcing their increased powers caused his Society almost to despair of any considerable permanent improvement. They were, however, directing their attention now to getting gas more generally used for motive power, and for cookery, &c. There was one great obstacle to the supply of cheap gas, as suggested by Prof. de Chaumont, viz., that it would involve laying a second set of mains, which would be a costly undertaking. In Manchester they were already very heavily taxed in connection with the gas supply, the gas department having to contribute £50,000 a year to the Improvement Committee. While that arrangement lasted it was not probable that gas would be so largely used for heating purposes as to call for the laying down of a second set of mains. If, however, Prof. de Chaumont's suggestion could be carried out generally, the smoke question would practically be solved.

Mr. Phéné Spiers (London) thought that the size of chimney flues ought to be brought under consideration. Architects and builders were obliged to make chimney flues which were excessively large, even in cases where they were for fireplaces in small rooms. In Paris his attention had been especially called to the small fires maintained in kitchen ranges, the large size of the oven, and the quantity of heat which it was possible to obtain. The flues from the large ranges in France were never more than nine inches in diameter, and were circular in shape, so it was certain we were greatly in excess in the size of the flues used here in England. He was astonished to hear that that question, viz., the size of flues, had not yet attracted the attention of the opponents of smoke production, because it was one of the first things that ought to be attended to.

Professor de Chaumont, M.D., F.R.S. (Southampton). I apprehend that the Act compelling the construction of large flues was in order that the chimney sweeper's boy could go up them. Now that the boy has been abolished, I think the size of the chimneys ought to be altered.

Mr. W. Tattersall (Bradford) observed that in many places of manufacture where gas was used as a motive power, there was a great disadvantage in the smell which was evolved from the gas and

which permeated the whole buildings, so that special apparatus had to be put in to remove it, which would not have been necessary if steam had been used. With reference to the cheapened supply of gas for heating purposes, he remarked that he had lately come in contact with a gentleman who was endeavouring to introduce an appliance for the manufacture of gas by forcing atmospheric air through a certain liquid. If that idea could be carried out it would do away with the objection to lay extra mains for the supply of cheap gas.

Mr. J. GORDON, M.Inst.C.E. (Borough Surveyor, Leicester), said that Mr. Coles had dealt chiefly with the introduction of gas stoves for household purposes. Prof. de Chaumont recognised that in Leicester there was a very clear atmosphere, and he believed that was greatly due to the authorities carrying out the Smoke Abatement Act as fairly as in any other town, but it was also true that within the last year or two, Leicester had taken almost the lead in the introduction of gas stoves. The Gas Committee of the Corporation very wisely sent out pamphlets showing the advantages of gas stoves, the effect of which was that they had been introduced into over 3,000 houses. He should have been glad to hear from Mr. Coles some allusion to the character of the stoves themselves. There was in many instances room for complaint that they produced an unwholesome smell within the house. Then again, he should have liked to hear something about abating smoke in factory chimneys by the most approved construction of the furnaces and boiler fires. He would very much like to see more progress in the direction of improving the furnaces, so that they could get rid of the use of boilers for steam and other purposes, involving necessarily the production of smoke even for so long a period as that allowed by law.

Mr. COLES, in replying, said he had endeavoured in his paper to deal with principles and not with details. He had endeavoured to draw attention to the fact that smoke was injurious, that it could be avoided, and that it would be quite reasonable to put on additional pressure through the law in order to suppress the emission of smoke. With reference to the proper size of chimneys, he said that the area of a chimney should bear a relation to the magnitude of the operation which was to be carried on in the fire-space. He agreed with Mr. Ernest Hart, that they must not rely so much upon penalties as upon enlightened public opinion. He, however, recognised the fact that penalties in many cases were very inadequate, and if coercion was at all used it ought to be sufficiently strong to effect the object of repression. With regard to the price of gas, he said it was open to communities to follow the example of Leicester and acquire their own gasworks, whereby the profits of the undertaking could be utilized for the diminution of the rates or otherwise. The objectionable fumes from gas stoves arose mainly from the mistaken idea that they could use gas for heating and cooking purposes without efficient communication with the chimney. Gas stoves should always be connected with the chimney, so that the fumes could be withdrawn through the

flue. Another fact was that many gas stoves burnt what was called Bunsen, or atmospheric gas, which was very liable to be blown out, and a smell was caused by gas coming into the room. It was important when thus burning gas to have the gas jet area properly apportioned to the air supply, and also to prevent the jets "striking back," as it was called, which caused a very unpleasant smell from the gas burning imperfectly. In answer to Mr. Gordon's query, he said that the smoke from steam boiler furnaces could be reduced to a considerable extent, by the use of mechanical stokers of the best construction, if the boiler power was adequate. The reason of smoke in many cases was that the boiler power was inadequate, causing the fires to be unduly forced. By the use of gaseous fuel known as "Producer Gas," instead of crude coal, the smoke from steam boiler furnaces could be entirely prevented.

On "The Ventilation and Warming of Chemical Laboratories and Applied Science Schools Generally," by EDWARD COOKWORTHY ROBINS, F.S.A., F.R.I.B.A.

THE scope of the work of the Sanitary Institute of Great Britain is an ever widening one, spreading with the growth of general intelligence, and the public realisation of the usefulness of its mission. In my anniversary address, delivered in July, 1882, at the Royal Institution, I endeavoured to point out some of its more obvious aims and uses—incidentally mentioning the fact that "Contemporaneously with the spread of knowledge in sanitary matters in particular, has come a feeling of backwardness in technical education generally, and during the last 10 years, science schools of the character suggested by the conference of the Society of Arts on technical education of 1868 have been built, and are being erected throughout the country, by municipal authorities, as at Nottingham; by trade guilds, such as the City Companies of London and Bristol; and by private benevolence, of which the Josiah Mason College, at Birmingham, is an eminent example."

This year, Sir Lyon Playfair, in his inaugural address to the British Association at Aberdeen, has again brought into prominence the immense importance to this country of the scientific side of general education.

"My argument is," says he, "that no amount of learning *without science* suffices, in the present state of the world, to put us in a position which will enable England to keep ahead, or

even on a level with foreign nations, as regards knowledge and its applications to the utilities of life."

Others have followed Sir Lyon's lead, and enforced the necessity for a more systematic teaching of applied-science in buildings erected for the purpose and suitably fitted up.

In January, 1882, I accompanied Professors Armstrong and Ayrton of the City Guilds' Technical Institute on a tour of inspection of the science schools of Germany, Switzerland, Austria, and Bavaria, and in May following, read a paper at the Society of Arts upon the English and foreign schools and colleges we had visited together, and the systems of education they represented.

The contrast between the provision made abroad and at home for science teaching so impressed me that in 1883, I read a paper at the Royal Institute of British Architects on 'English and Foreign Buildings for applied-science and art instruction,' which I afterwards followed up by papers on the Fittings required for such buildings, and the various systems hitherto adopted for heating and ventilating the same. These studies opened my eyes to the fact that, in comparison with the continent, we may be said to have no professionally recognised scientific system for heating and ventilating *public buildings* in this country, and I resolved to embrace the first opportunity which occurred to introduce to this country the principles in vogue in Belgium and Germany. As a member of the Executive Committee of the City and Guilds of London Institute for the advancement of technical education, I was soon enabled to introduce Mr. Bacon, of Antwerp, to the Architects of the Institute, and the Finsbury Technical College and the Central Institution at Kensington were heated and ventilated by the firm established by him in Antwerp and London. The Yorkshire College was also put into the same hands about the same time.

The method of computation by which the amount of heat required to warm the building itself and the incoming fresh air was ascertained, and the system upon which the sizes of the flues for the extraction of foul air were calculated, are given in full detail as an appendix to my paper "On the Relation of Sanitary Science to Civil Architecture," delivered at the Royal Institute of British Architects, in November, 1880, and in a subsequent paper a full description is given of the various systems adopted for heating and ventilating the three institutions already cited, and also a fourth, viz.: the Merchant Venturers' School at Bristol.

The provocative cause of my writing the present paper on the ventilation and warming of chemical laboratories and of science

schools generally is the fact that, through the munificence of the Merchant Venturers' Society of Bristol, I have had the opportunity of realising my own views of the requirements of such schools in designing and erecting the trade and mining school of that city—the whole expense of which has been defrayed by that society. The confidence reposed in me, as their architect, has given me the opportunity I desired of working out a sanitary problem, especially in connection with the heating and ventilation of such buildings.

A tabular statement of what we intended to do, and what we really achieved, hangs on the wall; and I venture to think that the theory and the practice have no need to be ashamed of each other, as we shall presently see.

Perhaps there is no class of buildings in which the application of sound sanitary principles is more important than public and private educational buildings, where large numbers congregate and remain for many hours in confined spaces, occupied all the time in work of an absorbing character, and necessitating in consequence the free circulation and constant renewal of pure, and the withdrawal of foul air.

But, as I have elsewhere shown, in applied-science schools we have not only to deal with the close atmosphere arising from the congregation of many persons in one room at the same time, and for a long time together, but we have to contend against the obnoxious smells caused by the experiments carried on in the various laboratories. The removal of these fumes with the greatest rapidity and certainty is best accomplished when the current of air in the extracting shafts of the ordinary room-ventilation is in the same direction as that of the draught closets and combustion hood shafts on the benches or around the walls. This is so obvious when thus plainly put, that it will be hardly credited that in the majority of cases the reverse is the fact, thus necessitating the closing of the extract gratings for the ordinary room-ventilation, that they may not pull against the extracting shafts from the operating benches and draught closets.

The velocity at which the extraction of the fumes created should take place in the draught closets must not be less than 5ft. per second, or 300ft. per minute. To ensure this draught at a constant velocity, it is necessary to be independent of casual winds and changing temperature as means of motion. This requires the employment of special apparatus to produce either a propelling or a sucking force, of which the latter has usually been a common upcast shaft or lofty chimney flue, either heated at its base by a special furnace, or by the product of furnaces required for steam engines or for heating apparatus.

Neither of these, however, can be depended on for constancy, and therefore the best motive power is a rotary fan, such as Blackman's or Aland's. The rotation of this fan is to be effected by a steam, gas, or electric engine, where water power is not available, which steadily exhausts the air from the air channels, and establishes an upward and outward current in the upcast shaft from the point at which it debouches.

The position in which this extracting fan is placed in the shaft determines whether the vertical air channels shall have an ascending or descending current established within them before reaching the shaft. If placed above the roof level the current will be ascending, and if placed below the basement at the foot of the shaft the current will be descending, to communicate in each case with horizontal channels graduated in size, in accordance with certain formula, until they reach the spot where the fan is situated in the shaft.

Of course it is apparent that a corresponding amount of fresh air, warmed on its entrance in winter and cold in summer, must be introduced through vertical shafts or gratings not fixed in the face of the side walls, so as to preserve an upward current, to replace the bad air extracted.

In summer the room openings or gratings for the escape of the foul air must be at the top of the wall opposite to that through which the fresh air enters; but in winter, if openings are not also provided at the bottom of the room so that the upper can be closed, the warm air will be carried away before warming the room; in either case the air may be pure, because it will never have time to get stagnant, but will always be changing as many times in the hour as may be predetermined, which is usually four times, allowing 700 cubic feet per person per hour.

In chemical laboratories, there are horizontal channels of communication between the extract flues and the operating benches, and draught closets either over or under the floors.

These channels vary in construction, but must be of calculated graduated sizes, proportionately increasing in size with the number of feeders in their length, allowance being made for friction. Those at Finsbury, very carefully laid down by Dr. Armstrong and Mr. Bacon, were of the same depth throughout, but graduated in width, and were formed in the layer of concrete, 8 inches thick, laid over the fire-proof floor of the laboratory, lined with Portland cement, pitched inside and covered with plate glass puttied in; over which were movable iron coverplates set flush with the floor. The wastes from the sinks were carried in similar channels to the outfall pipes. At Munich and Strassburg are asphalted channels for this purpose, and for

gas and waterpiping. At the Bristol School these air channels are of wood, pitched inside.

The Finsbury College, the Central Institution, Kensington, and the Bristol Trade School, have all been calculated on the same basis of temperature and volume of fresh air for ventilation, —viz., from 60° to 65° Fahrt. in the class rooms, and 55° in the entrances, staircases, and corridors, during an external temperature of 25° Fahrt., with a ventilation equal in volume to 700 cubic feet per person per hour in the class rooms, and 3000 cubic feet per person per hour in the chemical laboratories.

At the Central Institution, and at the Yorkshire College, steam-heating has been employed. The air is propelled in each of these cases, and the result has been entirely satisfactory.

At Finsbury, high-pressure hot water piping has been used, and the piping has been concentrated in a chamber, through which the fresh air has been forced by a Blackman's fan, and so by vertical shafts in the walls, to the various rooms to be warmed.

Concerning this system of warming, Dr. Armstrong makes the following remarks: "Our experience has shown that the system adopted at Finsbury College is on the whole satisfactory, but several defects have been discovered which are partly inherent in the system, and partly faults in construction. The chief merit of the system of propelling fresh air through a heating chamber by a powerful fan is its simplicity, and provided that the flues are so proportioned as to deliver the exact amount of air required to maintain the various rooms at the proper temperature, there should be no difficulty on this score.

"Although calculated with the aid of Professor Wolpert's elaborate formulæ, we find in practice, by careful test experiments, that the various flues do not all deliver air at just the rate and at just the temperature which is required for the efficient warming of all the rooms, and in some we are overheated and in others under-heated.

"Whether this is due to a misapplication of the formulæ, or to the omission of sufficient allowance for distance, or to the irregularity in the direction or formation of the flues, further experiments will probably reveal.

"The most serious objection to our Finsbury system arises from the fact that ventilation and warming are inseparable; in other words, if the temperature in any room be sufficiently high, and it is required to introduce more air, this cannot be done by the apparatus only, without also raising the temperature. It ought to be possible to admit warm and cold air in varying proportions, or, which is the same thing, to increase or diminish the supply of air, and at the same time diminish or increase its

temperature, so as to ventilate more efficiently while maintaining the temperature constant."

The Josiah Mason College is also heated from a huge basement chamber, without the employment of a fan, with a similar defective result. Therefore, in designing the Merchant Venturers' School at Bristol, I adopted a different plan, the apparent success of which has made me think it worth while to draw the attention of the Congress to it. In this case a direct application of the high-pressure hot water system has been employed, the heating surfaces being distributed along the external walls of every floor of the building, and concentrated in coils placed in slate-lined chambers in the window backs behind the oak dados; the fresh air passing through them by external gratings with internal iron regulating valves working in grooved frames—while the fan is used as an extractor instead of a propeller—so that the fresh air is drawn in through the coils by the suction of the extract shafts, in which the air is exhausted by the action of the fan.

To make this understandable, it will be desirable to refer to the plans which illustrate the building, and the following is the brief description which appeared in the pages of the "British Architect," at the time of the opening by Sir Frederick J. Bramwell, the President of the Institution of Civil Engineers, and Chairman of the Council of the City and Guilds of London Institute for the advancement of Technical Education, in July last. The temperature of the great hall, within which the crowded meeting was held, was considerably below the external temperature, and the variation of temperature within the hall did not exceed 1° Fahrt. during the whole of the protracted meeting, nor did it rise above 71° Fahrt.

"The Merchant Venturers' School, Bristol."

"The building is in the 14th century Gothic style, and is faced with red bricks with Bath stone dressings. It is situated in the rear of College Green, having one frontage in Union Street, and the other in Denmark Street, forming a handsome corner edifice, which it is hoped ere long will be extended to College Green, after the removal of the old houses which now conceal it from view in that direction.

"It is four storeys in height, and the lofty topmost storey is devoted to science teaching; the laboratories and their associated rooms follow one another in order, commencing at the S.E. angle we have the chemical lecture room, between which and the chemical class room is the preparation room with large glazed fume closets in the walls behind the Professor's tables,

communicating with the intermediate preparation room. Then comes the special balance room, between which and the special operations room and the gas and water analysis room is the head master's room, occupying the N.E. angle of the building. Beyond the gas analysis room is the general chemical laboratory for upwards of forty students, operating benches overlooked by the demonstrator's table on a platform with large and small draught closets and other fittings along the walls and benches.

"Opening from the western end of the large laboratory is the combustion room, and the north lighted general balance room.

"On the southern side of the central corridor is the metallurgical laboratory, with its wind and muffle furnaces and lofty chimney stacks sustained on arches rising on piers brought up from the basement. This room has a fireproof floor.

"Next comes the physical laboratory and lecture room adjoining. The upper part of this central corridor is thrown into these southern rooms, and forms an effective gallery reached by a special staircase.

"The first floor contains the engineering, drawing, and lecture rooms, and a series of general school class rooms, entered from the side gallery of the great hall, beyond which is the art drawing school at the north-west corner, over the caretaker's quarters.

"The ground floor contains a similar series of class rooms, entered from the arcade of the great hall or examination room, there being no closed corridor, in accordance with 'the hall passage system' recommended by the architect in his paper read at the Society of Arts on 'Secondary School Planning.' This hall is a striking feature in the building, its dimensions being 80 feet long by 44 feet wide and 26 feet high. It has a fine arcade of Portland stone shafts and arches on one side, and a series of fine lofty mullioned windows opposite, with an elaborately designed and skilfully executed oak roof, geometrically panelled with double sunk circular cusped ribs and boarding rising from fan-traceried pendants, richly moulded main timbers, and variously carved bosses, which with its pierced side and end gallery fronts and high dado of oak panelling all round, its red pressed brick and Bath stone banded walls, altogether produce a remarkably handsome 'tout ensemble.' The acoustic properties of the hall are excellent. This floor also contains the reception and waiting rooms, and the library and museum facing Denmark Street.

"The basement floor contains the main entrance gateway leading to the principal massa carrara marble staircase, with its marble mosaic landings and passages, which rises to the top-

most floor of the building. The boys' fireproof staircase is at the other end of the building next the caretaker's house in Unity Street. On this floor is the dining hall and cloak-rooms (one for each class room) through each of which access is given to the covered and open playgrounds, at the ends of which are the lavatories and conveniences, which last, with the drainage and plumber's work generally, combine all the latest and most approved sanitary appliances. The remaining rooms next Denmark Street are intended for workshops and gymnasium. The massive basement walls having to descend to the rock for a good foundation, extensive and very lofty wine vaults have been constructed as a sub-basement under the major part of the building.

"The singularly complete series of fittings throughout, have been partly executed by Messrs. Brock and Bruce, of Bristol, the general contractors, and partly by the North of England School Furnishing Company. Messrs. Hodkinson and Clarke provided the lift, with its special safety self-closing door arrangement."

With this general description of the building as a whole, we shall better comprehend the heating and ventilating arrangements so carefully worked out and ably executed by Messrs. Bacon.

1st. *The Heating Apparatus.*—There are two coil furnaces pyramidally set in brickwork; half of the wrought iron hot-water piping proceeds from one furnace, and half from the other. Both furnaces will only be required in very severe weather, when it will be in the power of the stoker to raise the heat considerably above the temperature stipulated.

This building is one of the first to which high pressure wrought-iron pipes have been applied, the external diameter of which is 1¾in., instead of the usual 1¼in.; and it has been found to be equally manageable, reducing the length of pipe required in proportion to the larger convecting surface obtained.

There are six separate circulations from each of the two furnaces, by which expedient the return pipes are kept at a high temperature. The heat is concentrated in the coils of various calculated sizes enclosed in slate cases, so that the oak dados may be continued round them. The coils are situated in the window backs, and the two flows and two return pipes leading to them are covered with asbestos cement and give out no heat, harmlessly passing behind the plinth of the dados, so that the system of heating is invisible, though at all times get-at-able. Each coil is thus entirely under the control of the master present, in whose desk is the key which opens and closes the valves or disconnects the hot-water coils. For observe, each

coil may be separately cut off from the general circulation without interrupting the flow elsewhere, or it may be but partially opened, as the temperature may demand, by turning the three way stop-cocks provided more or less fully on.

To prevent accidents by frost, the pipes are filled with a non-freezing solution of chloride of calcium, and the fresh air is freely admitted at all seasons of the year and passed through the coils at pleasure by the opening or closing of the valves over the gratings for the admission of cold air. To ensure its being well-heated on its entrance, the air is conducted in its passage through the coils over horizontal baffle plates, and so into the room, with an upward current, through the iron grating let into the window boards over the slate coil casing referred to.

The regulation of the exact amount of heat desired for each room, and the cutting off of any room or rooms not requiring to be heated, is achieved in this way, while the purity of the incoming air is preserved and the supply given independently of the heating apparatus, with which, however, it may be immediately associated.

2nd. *The Ventilating Apparatus.*—In every room there are at least two extract ventilating gratings opening into the flue or vertical shaft in the thickness of the wall, of calculated area, within which a descending current of air is provoked by the action of an Aland's fan, turned by a gas engine, which is competent to deliver a million and a half cubic feet per hour. These vertical wallshafts are connected with a collecting horizontal channel of calculated dimensions, situated under the whole length of the central basement corridor floor, and is in direct communication with the fan placed about 10 feet up the exhaust shaft. The upper of the two extract gratings in each room is for summer ventilation, and the lower is for winter ventilation.

A special wall-shaft communicates with the large chemical laboratory, and the various fume closets and operating tables, all of which are pitched inside, the air being drawn through them at the rate of 300 feet per minute. From every part of the building the air is changed about 4 times in the hour, the provision being generally 700 cubic feet per person per hour.

I think we may now say that Dr. Armstrong's suggestions have been met in the present instance. It may, however, be thought that so much ventilation would produce draughts, but the contrary has been the result. During the testing, to which I will presently refer, I threw my handkerchief against one of the class room wall extract ventilators and it stuck there, the pull overcoming its weight; but I found by applying the

anemometer to the orifice, at a distance of only 12 inches, there was not sufficient draught to turn the wheel of the instrument.

I have only now to draw your attention to the table of results obtained, which I have caused to be placed on the walls. I think they fully justify my commendation of the system employed. In spite of my endeavours to get this tabular statement complete in time for the Congress, I am only able to give the *first trial before any adjustments or corrections have been made*, but the result of the comparison between the theoretical statement written in black ink, and the practical result written in red ink, shows that whereas 1,209,734 cubic feet per hour was proposed to be extracted from 21 of the rooms, 1,259,900 cubic feet per hour has been realised.

In the Great Hall 350,000 cubic feet were to be extracted in the hour, really 331,000 are extracted; the 8 class rooms were designed to extract 35,000 cubic feet per hour, and upwards of 41,000 cubic feet are extracted; the Chemical Laboratory, at 3,000 cubic feet per person, was to have 120,000 cubic feet per hour extracted, really 123,900 cubic feet are withdrawn in the hour.

Greater variation in detail takes place in other rooms, but these are capable of adjustment. The power of adjustment exists and will be exercised till the theory and practice coincide, Messrs. Bacon having staked their credit upon the ultimate success throughout.

Mr. H. Saxon Snell, F.R.I.B.A. (London), opened the discussion on Mr. Robins' paper by remarking that the building just described was apparently as unique in the completeness of its details as were all other buildings of a similar kind designed by Mr. Robins. The only point where he should fear failure was in the methods adopted for heating and ventilating the various rooms. The former was described as a system of heating by hot water, but it was in reality steam—compressed steam—and in England this was very generally condemned. What he feared, from Mr. Robins' description of the ventilation, was that sufficient heat had not been provided; for, as he understood it, the openings into the outlet shafts were situated in the upper and the lower parts of the room, but the upper outlets could only be used when the room had become sufficiently heated. It was a mistake that this necessity should exist for closing these upper outlets, for, in order that we should be prevented from re-breathing our foul exhalations, it had been ordained that they should leave our bodies at a higher temperature than the surrounding atmosphere, and so rise into the air above, and there become purified. But, during the

time of insufficient heating, and when therefore the top ventilators of this building were closed, these foul emanations would rise towards the ceiling and then necessarily descend towards the outlets situated near the floor level; and so, passing by the breathing apparatus of the occupiers of the room, would wholly or partially be again drawn into their lungs. Mr. Robins had said that the air being drawn away from the room at the rate of 700 cubic feet per hour, the residue was pure; but if he had read Prof. de Chaumont's works rightly, it would be necessary, to ensure purity, that a much larger quantity per hour should be removed than 700 feet. He understood Mr. Robins to say that the anemometers employed in determining the rate at which the air was removed had not been tested, and therefore the results could not be looked upon as reliable.

Mr. Rogers Field, M.Inst.C.E. (London), said he had had a great deal to do with testing anemometers, as a member of the Cowl Committee of the Sanitary Institute, and had found the ordinary instruments to be incorrect. The committee went to the fountain head to buy instruments, and ordered them to be made as accurately as possible, but after being submitted to very careful tests the readings of the instruments (after applying the corrections supplied with them) were found not to be accurate. The tests were carried out by means of an experimental gas holder, only with air instead of gas, and then by drawing the holder up, or sending it down a certain distance a known quantity of air was forced through the instrument, and thus the actual velocity of the air passing through the instrument was ascertained and accurate corrections were deduced.

Mr. Ernest Day (Worcester) observed that heating and ventilation was a subject upon which a large number of theories were promulgated, and very often these theories did not in any degree answer the expectations of those who advanced them, therefore it was a matter of congratulation that Mr. Robins' experiment had been so satisfactory. With regard to the passage of air through hot water coils, he thought from practice the principle was a decidedly correct one, and the result of Mr. Robins' ingenuity upon this and other sections of the work carried out must be very gratifying. His experience had led him in favour of carrying off vitiated air from the upper part of a room. He had tried the lower part of a room and could not say that his experiments had been very successful.

Mr. W. R. E. Coles (London) said the method of heating adopted by Mr. Robins was doubtless a satisfactory one, because heat could be obtained from furnaces burning coke or other smokeless fuel, which was a great advantage. The system was also one that lent itself readily to methods of ventilation. With regard to the correctness of the tables submitted by Mr. Robins, based upon tests by the anemometer, so far as he (Mr. Coles) was able to remember the variations which Mr. Field and Mr. Snell had referred to as being found in the working of wheel anemometers, the mean variation was

substantially very small indeed. It would only be equal, in the case of some of the chief rooms mentioned by Mr. Robins, to something under 200 cubic feet of air; and, therefore, the correctness of the instruments was not an important factor in the consideration of Mr. Robins' plans. He (Mr. Coles) said that he must take exception in the most emphatic manner to Mr. Snell's and Mr. Field's wholesale denunciation of wheel anemometers. Those instruments had been used very largely by the Smoke Abatement Committee and others in testing fire grates and furnaces of various kinds, and it was found that the anemometers gave results consistent with the calculated velocity of air currents due to chimney levity. Thus there was a check upon the register of the anemometers, and though he did not say that they were absolutely accurate, he did say that wheel anemometers of good construction, properly corrected and properly used, were very useful and fairly reliable instruments for measuring the velocity of aerial currents.

Mr. D. Emptage (Margate) said the discussion had brought out, very clearly, the fact that there were great variations in the results given by different anemometers, and it would be very useful if some reliable information could be obtained respecting them. Some years since a committee was appointed for the purpose of testing cowls. Those gentlemen had given the question of anemometers a very large amount of attention, and were therefore in possession of valuable information respecting them, which he hoped they would shortly lay before the public.

Prof. F. S. B. F. de Chaumont, M.D., F.R.S. (Southampton), said that the difference in registration of the anemometer appeared to be considerable according to Mr. Snell. He would, however, modify the inference to be drawn from that by saying that if that error were constant, as they might presume it was, the error was not very material in considering Mr. Robins' figures, because if the instrument registered wrongly in one case it would do so in another; still, for the purposes of comparison, the figures might fairly hold good. With regard to the action of the Cowl Committee of the Institute, it was only when that Committee started that it was discovered what a large and important question came before it. The labours of that Committee were brought to a standstill from the fact that they found anomalies which could not be corrected in any visible way, and they were driven to the point that the anemometers themselves must be exhaustively tested. Mr. Snell made an ingenious apparatus by which he ascertained the actual error of the anemometer, but it became perfectly evident that the funds which had been collected were totally inadequate to carry out the extensive enquiry, and the Institute was not in a position to advance funds. Funds, however, had since been provided, and he believed the labours of the Committee were approaching completion, and they were in hopes that their report might soon be ready for publication. He need hardly say that

when it did appear, it would be the result of a most exhaustive enquiry. With regard to the paper read by Mr. Robins, the subject of ventilation was always a difficult one, and the ingenuity of professional men was often sorely taxed. As to the question of taking foul air out at different altitudes, he thought the upper part was the natural point from which it should be drawn. In one well-known system, that of the model prison at Pentonville, the plan was followed of taking the foul air out at the bottom of the prison cells, and letting in fresh and warm air at the top. He made a careful examination of it and found that the plan was not satisfactory. Ventilation as an art was very much in its infancy, and one of the great difficulties which was to be overcome was the number of angles which it was necessary to introduce into the shafts. They must remember that every time they bent a shaft at right angles they diminished the current through it by one half, and of course every other angle would be in a proportionate degree affected, which could be stated in a mathematical formulæ, although it was not worked out at present. The paper said that the air was to be changed four times per hour; if so every person could only have 175 feet of air. When Mr. Snell referred to his (Prof. de Chaumont's) own writings on the subject, 3,000 cubic feet of air was recommended as the proper amount; that chiefly relates to dormitories, and to the condition of things when people were asleep. But in the case of rooms where people meet for a short time, although it would be highly desirable to have that amount of air, yet the difficulties in the way of that amount were practically insurmountable. It was shown that practically speaking the atmosphere of a room became in the uniform condition of permanent occupation after two hours, *i.e.*, if people remained more than two hours, it was the same as though they had remained twenty hours. The amount of impurity did not change, given that the amount of air supply was continuous. When they brought people together in a room, the difficulty of giving the amount of space to allow such a quantity of air was really insurmountable, therefore they were obliged to be content with a smaller amount of air, not that they thought it a desirable thing, but simply on account of the impossibility in practice. The question arose whether they could accept a lower standard of purity for temporary assemblies of people, or must they insist upon the standard for first-class ventilation. Arranged as matters were it was almost impossible to obtain that, so they must be content with a smaller amount of air, so the objection on that point was not so stringent as the statement of Mr. Snell would seem to indicate.

Mr. E. C. Robins, F.S.A. (London), in replying, said he hoped that the time was not far distant when they would know the results of the experiments of the Cowl Committee. Particular care was taken, on his part, and by Mr. Bacon, to ensure the accuracy of the figures he had submitted to them, which were the result of the first few days' testing; and he was bound to say that they were of value in connection with that subject, as showing theory and practice contrasted. He thought many of them must have forgotten that all the rooms

referred to by Mr. Snell were ventilated at the top, as he advocated. But they were also capable of being ventilated at the bottom, so that if the upper ventilators take away the heat too rapidly in winter, provision is made for a change by carrying the shaft down to the floor; so that the upper gratings may be closed, and the extraction take place through the gratings near the floor. He thought he had shown that he had sufficient heat, and for the most part of the year would require but one of the boilers: it was not want of heat, but proper circulation that had to be met, because he did not want to waste heat. He believed they heated their rooms too much, as a rule; and though he advocated artificial appliances in special cases, he most delighted in open fire radiation, in spite of the Smoke Abatement Society. Prof. de Chaumont had remarked on the practical difficulty of realising theoretical perfection. But though the entire space allowed for each of the fifty scholars in each class-room was small, yet 35,000 cubic feet of air was passed through them in the hour, which, divided by 50, gave 700 cubic feet per person per hour, as he (Mr. Robins) had said; and he was glad to find Prof. de Chaumont considered it sufficient.

On "Plumbing and Plumbers' Work," by FREDERICK SCOTT.

A movement has recently been inaugurated by the Worshipful Plumbers' Company of London, which may well claim the attention of the Congress and the hearty support of the Sanitary Institute of Great Britain. Its object is to raise the status of plumbing as a craft, and thus promote in the interests of the public an improvement in a class of work upon which health so largely depends. It is not asserted that all plumbers' work is now-a-days of an inferior quality; on the contrary, it is admitted that more good work is now done than at any former period, but most householders can, from sad experience, testify to the fact that inferior or "scamped" plumbers' work prevails to a very considerable extent. For the information of those who are so fortunate as not to have had any direct experience of bad plumbing, I would mention a series of illustrated articles on "Defective Plumbing" by Dr. Francis Vacher, the Medical Officer of Health for Birkenhead, now appearing in the *Health Journal* of Manchester. Here we have cases of the most atrocious character described, vouched for by Medical Officers of Health and others as coming under their notice almost daily.

In October 1884, the Plumbers' Company held a Conference at the Health Exhibition, and the decisions then arrived at are, shortly stated, as follow:—that the evils now experienced from bad plumbing are substantially traceable to four causes: 1st, the identity of the plumbers' craft being, to a great extent, lost or obscured through the merging or the amalgamation of the various branches of the building trade, houses are now built in large numbers without any sufficient definition of the plumbers' work, and the natural consequence is that it is done "anyhow" and by persons who are not really plumbers. Though it may perhaps not only be necessary but desirable that plumbers' work should be done by builders, it is still essential that the identity of the plumbers' craft should be preserved as a distinct craft. 2nd, The system of apprenticing lads for a term of years to learn the trade has fallen off to a great extent, and in conse quence there is a great influx of men who are not properly qualified plumbers. 3rd, That while there have been considerable changes in the character of some of the materials used in plumbing work, the standard qualities of such materials have not been determined by custom or the general assent of the trade, and the result is that there is much uncertainty as to the selection of material, and much that is unsuitable is used. In former years when lead and solder were chiefly used in plumbing work, they were assayed and stamped by the Plumbers' Company to define the value, not only as a safeguard against fraud, but as a convenience and an advantage to traders tendering to do plumbing work, and to persons ordering it. 4th, The public regulations which deal with certain details of the construction of new houses and their connection with the public sewers, do not sufficiently recognize the importance of securing the efficiency of the plumbers' work done in those houses. To meet as far as may be these several evils, it is obvious that public knowledge and public interest in the subject must be enlarged, and it is equally obvious that it would be quite impracticable for any mere organisation of plumbers to carry out single-handed the necessary reform. With a view to remedying this state of things the Plumbers' Company have formed a Committee embracing plumbers, architects, engineers, builders, sanitarians, representatives of institutions for technical instruction, and of societies for the promotion of sanitary reform, and others who from their known sympathy with the object in view, and their connection with the legislature or municipal bodies, can help to forward the work. Only one meeting of this council has yet been held, when the following resolutions were adopted, viz: That the Plumbers' Company be requested to establish a system of Registration of Plumbers of the City of London, and within a circuit of seven

miles thereof. The Register to include master plumbers and journeymen. The Register to be open to the admission of those who satisfy the Court of their qualification by either of the following means: 1. Evidence of present status and experience in the trade. 2. Examination by Boards of Examiners composed largely of practical plumbers appointed for the purpose by the Court. 3. Production of Certificates of Competency granted by the Plumbers' Company and the City and Guilds of London Institute, due weight and consideration being given to the production of indentures of apprenticeship. That the Court reserve the right to remove names from the Register in cases of proved misrepresentation, or other gross misconduct injurious to the trade and the public. That plumbers admitted to the Register be authorised to use the letters R.P. (registered plumber) after their names. That it be remitted to the Plumbers' Company to adopt such working arrangements in regard to the Registration, and the public announcement of names and addresses of persons admitted to the Register as may be found most agreeable and convenient to the trade.

The consideration of the organisation of provincial boards of examiners of plumbing work and other business was postponed to another meeting.

In connection with the arrangements for Registration, provision will be made for instruction in plumbing at Technical Schools, similar to what has for some time been included in the curriculum of the City and Guilds of London Institute, whose Plumbing examination papers, as published in some of the sanitary journals, indicate that great thoroughness of training is required from students. In the prospectus of the Manchester Technical School for the current year the notice relating to Plumbing Classes is as follows: "The course of instruction is intended to meet the requirements of apprentices and young journeymen who desire to obtain a knowledge of the principles of their trade, and will be fully illustrated by drawings, examples and experiments. The theoretical instruction will be supplemented from time to time by practical demonstrations in the laboratories. During the session 1885–86 it is intended to deal with the following subjects: —properties, qualities, uses and manufacture of the various metals and other substances used in plumbing. Action of water, air, gas and acids upon various metals. Theory and practice of soldering. Tools used in Plumbing. Gas and Water fittings and meters. Methods of testing pressures. Sanitary arrangements. Methods of testing water and other closets. Water supply. Roofing. Rain drainage of houses. External work."

The Manchester and Salford Sanitary Association, recognising from the outset the great importance of the work undertaken by

the Plumbers' Company, arranged for co-operation with that body as its plans should be developed, and all now bids fair for at least one important provincial centre keeping abreast of London in this useful work. Another important feature in the scheme of the Plumbers' Company is the inspection of plumbers' work in new houses, thus completing the system of protection of the public against inferior work. Besides Manchester, Leeds, Leicester, Birkenhead, Dublin and Gloucester are represented on the Council organised by the Plumbers' Company, and the list may be indefinitely extended; thus it may be regarded as only a matter of time for the movement to permeate the whole country. The more speedily it does so the better for the interests of the public health, and on this ground it is not out of place to bespeak for it the influential support of the Sanitary Institute of Great Britain.

Mr. D. Emptage (Margate) opened the discussion by remarking that he thought very great credit was due to the Plumbers' Company for the efforts they were making to improve the trade and protect the public from the evils arising from bad plumbing. At the same time he did not think that registration only would satisfactorily effect that object. He could see no reason why a plumber could not scamp his work as easily after as before registration. Bad plumbing arose from three sources: (1) the incompetent workmen; (2) competent workmen wilfully doing bad work; (3) the present system of competition, and the demand for cheap work. He hoped the Plumbers' Company would carry out their original programme, and not relax their efforts until legislation has been obtained, by which the public would be effectually protected. In America there was a very strong plumbing law in operation; only very recently a jerry builder there was sentenced to nine months' imprisonment, in addition to a fine of 2,000 dollars, for a flagrant violation thereof.

Mr. W. R. E. Coles (London) said he thought that the incompetency mentioned by the last speaker would to some extent be remedied by the spread of technical education, and the execution of bad work would be checked in some degree by the fact that registered plumbers would be liable to removal from the register in cases of wilful bad work. He further said, he thought it was all-important that a body of position and repute like the Plumbers' Company should come forward to represent the plumbing trade and initiate measures of reform.

Mr. E. C. Robins, F.S.A. (London), as a member of the Executive Committee of the City Guilds of London Institute for the advance-

ment of technical education, said it was greatly to be regretted that plumbers had ceased to be masters in the sense of having pupils in whom they took an interest; but he hoped that plumbers would continue to take an interest in the young men apprenticed to them. A cause of bad plumbing was doubtless the low prices which existed in consequence of competition, and masters did not give themselves the trouble to see that the details of their work were properly executed. He could not help thinking that the new association was calculated to be of enormous advantage, if properly organised and developed; but if it was worked only in the interest of the masters, and to get rid of the necessity of taking and teaching apprentices, he hoped it would fail.

Prof. F. S. B. F. DE CHAUMONT, M.D., F.R.S. (Southampton), said the question certainly struck at the root of the greatest part of domestic sanitary work, which was at the root of all sanitation and health. The stories of scamping plumbers were infinite; and the speaker caused some amusement by relating an anecdote showing the careless way in which some workmen performed their duties.

Mr. F. SCOTT (Manchester), in replying, said he agreed with Mr. Emptage that there was need of stringent legislation. If they found a man attempting to pick a pocket, they gave him in charge of a policeman; and that a man should be permitted to endanger knowingly the lives of a whole household, by bad plumbing, seemed incredible.

SECTION III.

CHEMISTRY, METEOROLOGY AND GEOLOGY.

ADDRESS

By William Marcet, M.D., F.R.S.

PRESIDENT OF THE SECTION.

Subject.—"On the Distribution and object of Carbonic Acid in Nature, and its Sanitary relations."—"On the influence of Altitude on the Chemical Phenomena of Respiration."

Part I.

It was first shown by Lavoisier, that whenever coal or charcoal is burnt, the combustion is attended with a combination of carbon with oxygen. From this chemical action there result two compounds, carbonic oxide and carbonic acid, carbonic acid holding twice as much oxygen as carbonic oxide. Carbonic oxide is a gas highly poisonous even in small proportions. It may be seen burning with a blue flame in our ordinary house grates, when the combustion of the coals is incomplete, and in certain manufactures it may be given out in very large quantities. Thus the gas evolved from Iron blast furnaces contains 25 to 32 °/₀ of carbonic oxide. The late distinguished Physiologist, Claude Bernard, has shown that this gas arrests life by destroying the functions of the blood corpuscles; the deleterious effects of carbonic acid are of a totally different character.

Carbonic acid gas takes a part in the phenomena of nature, the extent and importance of which are in general scarcely realised. Volumes of this substance are poured out daily from our house chimneys, and produced by the coals burnt in our manufacturing districts. Man and animals also give out carbonic acid, and reckoning at 8 grains per minute the amount expired by every person, it would follow that the 122,376 inhabitants of the town of Leicester would exhale 139 pounds of this gas per minute.

It is, at first sight, remarkable that carbonic acid gas should not accumulate in the air of those districts where it is mostly produced; and also that being, as it is, heavier than the atmosphere, it should not form into a dense layer on the surface of the earth. That this should not be the case is due to a very interesting property of the gas in question, namely, its diffusibility. By diffusibility must be understood the power the gas possesses of distributing itself throughout the atmosphere. Thus it is, that in a room crowded with people, all expiring carbonic acid at the rate of about 4 per cent. of the air breathed, the gas moving in every direction will spread itself throughout the apartment, so that a cubic foot of air will be found to contain the same proportion of the gas as another cubic foot taken anywhere else in that same room.

Carbonic acid is diffusible not only in air, but also in water under the atmospheric pressure. Sea and lake water contain carbonic acid derived from the atmosphere, indeed it is difficult to obtain distilled water free from carbonic acid; and in a long series of experiments on respiration, requiring the use of distilled water absolutely free from this gas, I was often compelled either to distill the water myself, or boil it, which had the effect of driving off any carbonic acid that might be left in it. The only water naturally exposed to the air in which I could not detect its presence, was on the mountain pass of St. Théodule, at an elevation of 10,899 feet, where I tested water from an ice pool.

It is not a little remarkable that indiarubber, a substance resisting so perfectly the penetration of water, should be no check to the passage of carbonic acid gas. Thomas Graham showed, in 1862, that caoutchouc actually absorbs carbonic acid, and holds it, though by no chemical power. This gas equally finds its way by diffusion through a moist animal membrane, and is given out on the surface exposed to the atmosphere. The passage of carbonic acid from the blood, through the moist tissue of the lungs into the air breathed, is readily and clearly accounted for by this very diffusibility of the gas.

The vegetable kingdom derives carbonic acid from the air much in the same way as a damp membrane, throughout which the gas distributes itself. Our green hedges, our luxurious crops, our trees covered with foliage, all absorb a certain amount of carbonic acid from the atmosphere. This, indeed, must be the main source of the carbon used for the nutrition of plants, a certain amount being probably supplied from the roots. Some plants, such as those growing on rocks, must derive the whole of their carbon from the air, and it is stated

by Sachs, in his work on Vegetable Physiology, that the organic matter of terrestrial plants increases in weight in a soil deprived of all organic remains by calcination and washing.

Plants, under the influence of their green coloring matter or chlorophyl, together with exposure to light, fix or assimilate the carbon of carbonic acid and give out its oxygen; while at night, in the absence of sunlight, the process is reversed, and carbonic acid is evolved. When a plant increases in weight and bulk, the assimilation of carbon must be greater than its elimination at night; when no increase takes place, the phenomenon of waste must balance that of supply.

A recent enquiry by Dr. Julius Sachs, of Wurtsburg, has thrown much light on the phenomenon which attends the decomposition of carbonic acid, and assimilation of carbon by plants. According to this botanist, the primary action of plants on carbonic acid is the formation of starch, which, however, cannot take place without the presence of the green coloring matter and the influence of light. Sachs ascertains the rate of assimilation of carbon by determining the amount of starch produced. This he does by subjecting the leaves to a certain preparation by which they are blanched, and then steeping them in a solution of iodine, when they are colored blue; the amount of starch is estimated by the depth of color, varying from blackish blue to metallic black according to its quantity. This test—the author calls Iodoprobe—gives speedy and reliable results.

On examining a leaf by this method, the blue color is seen to appear exclusively in those places which had been colored green, showing that chlorophyl alone can produce starch. The process of the formation of starch in vegetables commences in the morning and attains its maximum in the evening. At the end of a fine summer's day, leaves are literally filled with this substance. At sunset, instead of the starch increasing in amount it undergoes solution, and throughout the night is being carried away by the leaves into the stem. Such is the speed of this function of plants, that by about four or five o'clock in the morning every sign of the presence of starch in the leaves has disappeared; by daylight the formation commences afresh. Thus, leaves which in early morning, before sunrise, were absolutely free from starch gave, two or three hours later, a reaction with iodine of an intensely black color.

If a leaf be placed under a glass bell-jar in the sun, together with a piece of potash to absorb the carbonic acid of the air, the assimilation or formation of starch comes at once to a standstill. In one experiment, after the lapse of an hour, not only had the production of starch ceased, but nearly the whole

of that substance obtained by exposure to the air during six hours had disappeared.

Sachs determined the amount of starch thus formed, by weighing portions of leaves of equal surfaces at different periods of the day, and selected for that purpose the large leaves of the sunflower, rhubarb, and pumpkin. He finally measured the total surface of the leaves of a sunflower and a pumpkin; the former, with 145 leaves, exposed to light an assimilating surface of 1·5 square metre (16·146 square feet), and 116 leaves of the pumpkin measured together 7·3 square metres (100·467 square feet). In a single day of 15 hours the sunflower was found to have produced 36 grammes or 555·5 grains of starch, while the pumpkin with its wide leaves had accumulated no less than 185 grammes or 2854·9 grains of this substance. Starch contains 42 per cent. of carbon, corresponding to 154 parts by weight of carbonic acid. I have calculated that 7371 cubic feet of air, under ordinary circumstances, would be required to yield enough carbonic acid to produce 100 grammes or 1543 grains of starch. Should a pumpkin have added to its substance 2855 grains of starch in the daytime, 13,636 cubic feet of air would have been required to supply the carbon for this starch, assuming of course the atmosphere to have been the only source of carbon in the present instance. This volume of air would be that contained in a very large room, such as a hospital ward, holding ten or twelve beds. It is usually admitted and taught that while the carbonic acid of the atmosphere supplies carbon for vegetable growth, all vegetable matter when dead is returned to the air as carbonic acid, as far as its carbon is concerned, either by undergoing slow oxidation in the process of decay, or by being burnt, or by passing through the animal body as vegetable food.

Although carbonic acid is so very diffusible, it is not found everywhere in the open air in equal proportions. That of the London streets, for instance, contains a little more than is found in the parks. There are, moreover, conditions of the atmosphere which have a marked influence on the proportion of carbonic acid gas it may contain. Thus, rain by washing out the air produces a temporary decrease of carbonic acid in the atmosphere; and the presence of clouds, and especially fogs, exerts a very marked influence on atmospheric carbonic acid.

It has been long known that clouds and fogs increase the proportion of carbonic acid in the air of towns. Dr. Angus Smith ("Air and Rain" p. 52) shows that in Manchester there is more of that gas in air in foggy than clear weather; while Dr. Russell, from a recent inquiry undertaken on the carbonic acid of the open air near St. Bartholomew's Hospital, London, has observed

that in the presence of fogs the proportion of carbonic acid in the air of towns may be about three times greater than it is in fine clear weather. This gentleman has kindly allowed me to have the diagram he has published, made into an enlarged lecture chart for the present occasion, and you will see by glancing at it to what extent the proportion of carbonic acid in air varies; increasing in foggy and cloudy weather and falling with a clear blue sky. The obvious reason of this phenomenon is, that in fine weather there is nothing to interfere with the diffusion of carbonic acid, while moisture or clouds or fog, by placing an obstacle to the distribution of this gas throughout the atmosphere will thereby increase its amount in a given volume of air. Indeed, it would appear that a close connexion exists between Climate and the proportion of atmospheric carbonic acid, giving the latter a meteorological character.

The well-known influence of autumn and winter fogs on health, predisposing to asthma and pulmonary inflammation, is not unlikely to be due, more or less, to this accumulation of carbonic acid in air, which must interfere with the interchange of carbonic acid from the blood with the oxygen of the air breathed.

The amount of carbonic acid in air varies in the day and night, being a little larger at night; this, indeed, might have been anticipated, especially in the midst of active vegetable life. Vegetation appears to be greatly concerned with the presence of atmospheric carbonic acid, as according to Prince Zadkiel, M.D., a gentleman known from his writings on Egypt, and to whom I have had an opportunity of referring in my book on Southern and Swiss Health Resorts, the air of the Valley of the Nile holds only one or two parts of carbonic acid in ten thousand, while in the air of the desert there is no trace of this gas.

Air at great altitudes.—The distribution of carbonic acid at various altitudes is a question which has not yet been settled in a satisfactory manner. Carbonic acid being generated from the soil or near the earth, and having more or less moisture or clouds to get through before it attains those dry regions where sunshine reigns supreme, the proportion of this gas in high mountains must change within wide limits. You are aware that in cloudy and foggy weather carbonic acid accumulates upon the surface of the land where it is inhabited, and on such occasions we would of course expect to find less of this gas in the higher than in the lower atmosphere; on the other hand, after heavy showers it might be inferred that carbonic acid gas would occur in excess in the regions above the clouds. Carbonic acid has actually been found by some chemists in higher and by others in lower proportions on high mountains than in the plains. Accord-

ing to the Brothers Schlagintweit and Professor de Saussure, it is in excess in high mountains; but more recently M. Truchot (Cpt. rends de l'acad., v. 77, 1875) has arrived at a different result. In this instance the carbonic acid was determined nearly simultaneously at Clermond Ferrand, 1,296 feet above the sea, at the summit of the Puy de Dome, 4,744 feet, and at the top of the Pic de Saucy, 6181 feet. The proportions of the gas in 10,000 feet of air, reduced to the freezing point and seaside pressure, were found to be as follows:—26th, 28th, and 30th August, Clermond Ferrand, 3·13 parts; 27th August, summit of Puy de Dome, 2·03 parts; 29th August, summit of Pic de Saucy, 1·72 parts. Showing a rapid decrease of the proportion of carbonic acid in air on ascending above the sea level.

It is therefore not improbable that just as the amount of carbonic acid near the sea level, or on the low levels of the earth, may vary to a considerable extent, so can it also be greatly modified on high mountains, causing the gas to be at times greater and at others less in the higher than in the lower atmospheric regions.

Sea Air.—As there is no direct source of carbonic acid over the sea, and as water absorbs carbonic acid, though in small quantity, especially when holding salt in solution, sea air might be expected to contain less carbonic acid than land air. A paper by Mr. T. E. Thorpe (Journ. of the Chemical Soc. of London, 1876) gives us interesting and valuable information on the subject. He finds the mean quantity of carbonic acid in the atmosphere of the Irish sea to be (from 26 experiments) 3·082 in 10,000; in that of the Atlantic (from 50 experiments), 2·953 the mean of 77 experiments being 3·00. If land air contains, as is usually admitted, 4 parts in 10,000, there is considerably less carbonic acid in sea air. It appears, moreover, that the carbonic acid in sea air experiences fewer and far less extensive variations than in land air. Its proportion is nearly the same in different latitudes, and is constant in the same locality throughout the year. Although a difference is known to exist in the diurnal and nocturnal proportions of carbonic acid of land air, Thorpe states in his paper that no such difference is to be discerned in sea air. The average carbonic acid in sea air during the day was found to be 3·011, and during the night 2·993 in 10,000.

Sanitary Relations of Carbonic Acid.

According as the carbonic acid in the atmosphere increases beyond its normal proportion, say 0·04 per cent., air becomes less and less fit for respiration. An idea of the extent

of the accumulation of carbonic acid in the atmosphere may be formed from the investigation of Mr. Weaver, of this town, who found 0·53 volumes per cent. of this gas in the room of a framework knitter in Leicester; in other work-rooms the amounts were 0·52 and 0·46, down to 0·211 (Parkes' Hygiene). The figures between 0·53 and 0·46 would represent about ten times the normal proportion of carbonic acid in the open air. It was thought until lately that this gas acted as a poison, but "Paul Bert," and other physiologists, have shown that such is not actually the case. I have stated, in an earlier part of this address, that in the phenomenon of respiration, carbonic acid diffuses from the blood through the substance of the lungs into the air of the bronchial tubes. Air on the point of being expired contains about 4 per cent. of carbonic acid, that is, a hundred times more than when inhaled, and is therefore very impure. Supposing the air breathed to hold 4 per cent. of carbonic acid, nearly as much carbonic acid would be absorbed by the blood as the blood would emit, consequently that gas would rapidly increase in the blood and produce asphyxia, by checking the phenomena of oxidation. A positive morbid effect is produced long before such a proportion of the gas is reached. Dr. Angus Smith, after confining one or more persons in an air-tight chamber, and analysing its air, expresses himself thus: " . . . but leaving out all the details, the great broad fact remains, that carbonic acid and other emanations from the person diminish the circulation and hasten the respiration, so that the effect is perceptible in a very short time when the percentage of carbonic acid reaches 0·18 per cent. or say, one-fifth of 1 per cent."

When the carbonic acid of the air breathed in Dr. Smith's air-tight chamber attained 3 per cent., the pulse became so weak that it was difficult to count the beats; moreover, a very unpleasant feeling was experienced. On one occasion, the carbonic acid in the air chamber increased to 3·9 per cent., and the Author remarks: "My breathing rose up to 26 inspirations, and my pulse became so weak as to cause alarm."

According to Paul Bert's experiments, small birds confined in a bell jar under the ordinary atmospheric pressure cannot keep alive when the air contains 14·6 parts of carbonic acid for 3·5 parts of oxygen, or say, 4 times more carbonic acid than oxygen. In Angus Smith's experiments, a person subjected to an atmosphere containing 3 per cent. of carbonic acid obtained from his own breath at the expense of the oxygen of the air inspired, would be breathing air holding six times more oxygen than carbonic acid, while pure air would contain 525 times more oxygen than carbonic acid.

Professor de Chaumont, the distinguished President of this Congress, in an interesting paper to the Royal Society, stated, as the conclusion of a large number of observations and experiments, that the proportion of carbonic acid in air can be estimated, within certain limits, by the sense of smell. Thus, a room holding air, "fresh," or not sensibly different from the external air, would contain an excess of 0·2 per 1,000 over the normal amount of carbonic acid in the atmosphere. A room rather close, or in which the organic matter begins to be appreciated by the senses, would contain 0·4 per 1,000 in excess of normal air. Air close, or where the organic matter feels decidedly disagreeable, would contain 0·6 per 1,000 in excess of common air. While air extremely close would hold 0·85 per 1,000 in excess. The relative values of carbonic acid would be: to air fresh, 1; rather close, 2·13; close, 3·46; extremely close, 4·66.

Experiments having important sanitary bearings were made by Claude Bernard in 1857. He has observed that birds can live when accustomed by degrees to breathe air more and more unhealthy by admixture with carbonic acid, while other birds, in perfect health and taken from the open air, when subjected to this same bad air would die either at once or very rapidly. It follows that animals weakened by exposure to impure air are less in want of air holding its full proportion of oxygen than healthy animals. The practical bearing of this experiment is very obvious, and it explains how people living in small, insufficiently ventilated dwellings, and having to keep their windows always closed against the cold air can apparently be doing well. This satisfactory condition is, however, a delusion and a snare, and the fact of the inmates of such houses withstanding impure air with apparent impunity must be owing to a weak state of health, that same air being unfit for persons of a strong and robust constitution. This also explains how people of advanced and sometimes of middle age require less fresh air for the enjoyment of health than others in the full possession of youth and strength.

I happened many years ago to meet with an opportunity of observing on myself the ill effects of the inhalation of carbonic acid gas. This was at an establishment of mineral baths, containing a large excess of carbonic acid gas. When the immersion lasts but a short time, say from ten minutes to a quarter of an hour, no ill effects are produced; indeed one is conscious of a rather pleasant titilation, as gas bubbles form and break on various parts of the body, but should the bath be prolonged unpleasant symptoms may follow. I distinctly recollect that after an immersion of twenty or

twenty-five minutes, I got out and dressed, though with the greatest difficulty, feeling very giddy and hardly able to stand. It took me a long walk before I could be rid of the effects of the bath, which were clearly due to the carbonic acid inhaled while in the water.

PART II.

On the Influence of Altitude on the Chemical Phenomena of Respiration.

From the circumstance that man is apparently destined to live in the plains and near to the sea level rather than on high mountains, any change of altitude will be more liable to bring him under the influence of diminished rather than increased atmospheric pressure. On ascending even but a few hundred feet, an exhilarating sensation of freshness of the air and of comfort in the act of breathing will generally be experienced; this I noticed one day as I was walking up to Les Avants, from Montreux, near the Lake of Geneva. I was then trying to make out at what height the exhilarating effect of increasing altitude would first be experienced, and found it to be about 500 feet above the lake. Most people can live comfortably in the Alps up to 5,000 or 6,000 feet; the temperature and degree of humidity of the atmosphere having apparently much to do with this kind of acclimatisation. On the rocky mountains of Colorado there are many towns 10,000 feet high, where from personal experience I can say that no inconvenience is felt from the lightness of the air, except, perhaps, at times when running or taking active muscular exercise in other ways. The air in that country is warm in summer in the daytime and very dry. On the other hand, the monks of the grand St. Bernard, who live in a damp and cold climate at an altitude of 8,115 feet, suffer much on that account. Though all of them young men, and selected as to fitness to stand rough and cold weather, most of them after a year or two suffer from rheumatism and derangement of the stomach, and have in consequence to leave the spot. It is remarkable that very few become consumptive, though bronchitis is frequent among them. This information I hold from the monks personally.

For the successful ascent of high mountains the principal condition is "training." Climbing has this advantage over balloon ascents that the rise is much more gradual and the functions of the body have time to accommodate themselves to

the change of pressure. A balloon not unfrequently makes a rapid start upwards, the change of pressure being so sudden that it may produce evil and even serious effects, where a gradual ascent would have been unattended with danger. The well-known ascent where Messrs. Sivel and Croce Spinelli lost their lives, probably proved so fatal on account of the great speed the balloon had acquired.

The particulars of this unfortunate expedition are related in the "Comptes rendus de l'académie" for 1875, by M. Tissandier, the only survivor of the three aeronauts, and a short abstract of this personal narrative might not be uninteresting on the present occasion:—

"The atmosphere exhibited on the 15th of April a peculiar condition. At 4,100 metres (14,763 feet) we floated on the level of light cirrhus clouds, at 7,000 metres (22,966 feet,) the car was surrounded by cirrhus, with an atmosphere full of crystallised particles. At this altitude of 7,000 metres no alarming symptoms had been shown by any of us, but at 7,500 metres (24,606 feet), Croce and Sivel were pale, and the latter, of a sanguine temperament, closed his eyes at times. At 7,000 metres we breathed repeatedly air containing 70 per cent. of oxygen gas, and were refreshed by it.

"At an altitude of nearly 7,500 metres (24,606 feet) we were motionless in the car, and certainly benumbed. Sivel then emptied three bags of ballast in order to reach and rise beyond the altitude of 8,000 metres (26,247 feet) which we had proposed to attain.

"From my recollection, which is very clear, of the benumbed state in such an altitude, the mind and body become by degrees weakened, though unconsciously; the dangers of the voyage are no longer contemplated, there is a knowledge that the ascent is progressing, and this is attended with a pleasant feeling. I soon felt so weak that I could not even turn my head to look at my companions; I wished to lay hold of the tube of the oxygen bag, but could not possibly lift up an arm. My mind is still however very clear; I continue observing the index of the barometer and read 280, which is rapidly exceeded. I wish to call out 'we have reached 8,000 metres,' but my tongue is paralysed. Suddenly, at 1.30 p.m. I shut my eyes and fall, losing all consciousness. At 28 minutes past 2 I awoke, the balloon was descending. I emptied a bag of ballast to check the speed, and could write a few lines in my note book, recording a pressure of 315$^{m.}$ (7059 metres), temperature—8°.

"A few minutes later Croce Spinelli, also recovering consciousness, seized my arm and called my attention to the fact that ballast must be turned out; he ejects it himself. The

balloon, very hot and air-tight, rose once more into those high regions from whence it had just descended. The valve should have been opened, but none of us was strong enough to do so; I then lost consciousness a second time.

At 3.30 I became able to observe the altitude which was 6,000 metres (19,685 feet). Croce Spinelli and Sivel were laying dead in the car. The subsequent examination of the barometric tubes showed that the pressure had fallen to 264 and 262 millimetres, which brings the maximum elevation to 8,540 metres (28,019 feet), and 8,600 metres (28,215 feet)."

Tissandier adds to the above narrative that he feels certain Croce Spinelli and Sivel would have survived had they been able to breathe oxygen.

Mr. Glaisher, in his memorable balloon ascent, lost consciousness at 29,000 feet, so that both parties appear to have attained the limits of respirable air.

From the above it will be seen that the respiration of oxygen gas when the air has become too light to keep up animation can, at all events for a time, maintain life. Chlorate of potash is a substance which, when heated, gives out oxygen, and is indeed used for the preparation of this gas; it is, moreover, largely employed in medicine. When Mr. Edward Whymper left for his well-known exploration of the Andes, I had occasion to suggest to him the advisability of taking out some chlorate of potash, to be used in case of need against the ill effects of deficient oxygen at great altitudes. I had been told by Sir Douglas Forsyth that when crossing the mountains of Cashmir on his way to Cashgar, at a height of 19,000 feet, he had found much benefit from the ingestion of this substance, when affected by the lightness of the air, hence my suggestion to Mr. Whymper. This gentleman made use of the medicine on several occasions, and informed me subsequently he had derived much relief from it.

It is very difficult to assign the altitude man and animals can reach. Interesting observations by Mr. Paul Bert on the influence of low pressures on animals show that they can live under pressures of 210 to 230 millimetres (8·268 to 9·055 inches), and that if instead of the pressure being reduced quickly, animals are gradually deprived of air, it is possible to extend the limits of life to 170 or 180 millimetres (6·693 and 7·087 inches).

On the occasion in which Messrs. Sivel and Croce Spinelli lost their lives, the rate of ascent was very rapid, and consequently the aeronauts were under the worst possible conditions to stand such a great fall of pressure; they lost their lives when the barometer had reached 10·394 inches, which cor-

responds to an altitude exceeding but slightly the limits established by Paul Bert from his experiments. High mountains are climbed under circumstances very different from those attending a balloon ascent. The immobility to which a person is subjected in the car of a balloon, added to the very low temperature of the air at great altitudes, are productive of a sensation of numbness and sleepiness, while the fall of pressure must add to the feeling of cold by diminishing the supply of oxygen for respiratory purposes. Moreover, the evaporation from the skin and lungs in the very dry air of the upper regions, must be attended with a corresponding production of cold, hence most circumstances unite to lower the temperature of the body, and consequently depress the circulation. On ascending high mountains the conditions are entirely altered. When about 10,000 feet high are reached the progress becomes in general much slower, and most climbers, unless strong and in excellent training, have to stop every few minutes to take breath. Mountain sickness often occurs at that altitude, and is in many cases an obstacle to any further progress. The main precaution to take in order to reach great heights is to move on slowly. It took many days for Mr. Whymper, and many long halts, to reach the summit of Chimborazo (20,517 feet).

In the season 1855–56, on the occasion of the magnetic survey of India, the brothers Robert and Adolph Schlagintweit. achieved a brilliant series of explorations and ascents. They remained ten days on the slopes of the great Gurhwal peak Ibi Gamin (25,500). Every bivouac during that time was about 17,000 feet, the highest reaching to an altitude of 19,326. Finally they ascended to 22,239 feet, which for a long time remained the extreme height attained.

In 1864 Mr. Johnson is reported to have climbed up to a ridge in the Ladak (Himalaya) which exceeded 22,300 feet, and in the following year he is said to have reached a height of 23,728 feet. Mr. Graham, and a Swiss guide in 1884, first rose to an elevation of 20,000 feet in the Himalaya, then 22,700 feet close to the summit of the Dunaghiri, which he unfortunately could not attain, though within 500 feet, on account of mist and hail. The greatest achievement of Mr. Graham and his Swiss companions Kauffman and Boss, was their reaching, according to his statement, the summit of the Gaben at least 23,700 feet above the sea.

While mountaineering in the Alps, it occurred to me that a careful investigation of the influence of light mountain air on the chemical phenomena of respiration might yield very interesting results. There was reliable information to be obtained in various published sources, on the general influence

of altitude on breathing, the most extensive perhaps being that of Dr. Jourdanet, who resided for many years in Mexico; but I could find no reliable work dealing with the actual chemical changes brought on by removal from a lower to a higher altitude.

In the year 1875 I tried various contrivances of a portable description to collect a definite volume of air expired, and submit it to analysis by Pettenkofer's process. Finally, a glass cylinder was adopted of a known volume, and an account of the process was published in the Journal of the Chemical Society for 1880. The cylinder is closed at both ends by glass plates, screwed down tightly, and a vacuum is obtained in it by means of a portable air pump. The air, after having been expired from the lungs into an indiarubber bag, is let into the vessel, and fills exactly the cylinder under the atmospheric pressure; thus a known volume of air from the lungs is collected to be submitted to analysis. I completed over 400 analyses of this description, the air having been expired at altitudes varying from 1,000 to 13,685 feet in the Alps, and from the sea-side to 12,000 feet on the Island and Peak of Teneriffe. A last series of experiments, made in 1883, has not yet been published, but it confirms in every respect the results previously obtained.

Before entering upon the account of my own work, I must acknowledge the investigation on the same subject of a Swiss gentleman, Mr. Mermod, who experimented on two stations in Switzerland, varying only from 1,100 to 3,202 feet; his results were published in 1877; he found the carbonic acid expired within a given time to be greater at the higher than the lower station, and that the volume of air expired, also in a given time, at the higher station, reduced to freezing point and sea-side pressure, was less than at the lower station; but he went no further. I shall have an opportunity of showing that these results, though correct as far as they go, do not admit of being generalised sufficiently to account for the real influence of altitude on the chemical phenomena of respiration.

In 1876 I ascended, with four porters carrying my instruments, to the well-known St. Théodule Pass, at an altitude of 10,899 feet, leading from Zermatt to Aosta, and remained there eight days, going up the Breithorn (13,685 feet) on three different occasions during that time. The results from this first series of experiments were not altogether satisfactory, and had to be considered as an introduction to subsequent researches.

In the summer of 1877 I experimented at the Hospice of the Grand St. Bernard (8,115 feet), at the Riffel Hotel, Zermatt

(8,428 feet), again at the St. Théodule Hut (10,899 feet), and at the summit of the Breithorn (13,685 feet).

In 1878, wishing to be free from the influence of cold at increasing altitudes, I made a journey with all the requisite instruments to the Island of Teneriffe, and spent three weeks on the Peak. On that occasion I selected three stations: one at the seaside, one at an altitude of 7,090 feet—where I camped out eleven days—and one near the summit of the Peak at 10,700 feet, where I remained ten days. The height of the Peak of Teneriffe above the sea is 12,200 feet.

In 1880 I returned into the Alps accompanied by a young friend, a scientific man, and we both submitted to experiment. On that occasion leaving Geneva, where a preliminary series of experiments had been made, we proceeded first of all to Courmayeur, at the southern foot of Mont Blanc, which was our second station, and finally we spent three days on the summit of the Col du Géant (11,030 feet), sleeping in its lonely hut. On that occasion three porters carried up my instruments, one of the cases weighing rather over 80lbs.

In 1883 I made a fresh series of experiments, being accompanied by another young gentleman, an engineer, also perfectly reliable as to the part he took in the experiments. We carried on the work both at Geneva and on the Righi, the Righi Staffel Hotel (5,230 feet), having selected this station in order to obtain the effects of altitude at the usual elevation of an Alpine sanitarium. As already stated, the results obtained confirmed those arrived at from the other experiments. Thus my investigations ranged over the period extending from the year 1876 inclusively, to 1883, being made in the summer time, one season only excepted.

The results I have obtained may be divided into two series; the first applies to altitudes in which a person can live in perfect comfort, and therefore adapted to the maintenance of health; the second series applies to elevations incompatible with the normal functions of the human body. As these altitudes vary considerably according to individuals, it is difficult to define them. I should say, however, roughly, that people dwelling in the plains or near the sea level may live comfortably for months or perhaps years, at altitudes not exceeding 6,000 or 7,000 feet in the Alps. In countries where the weather is generally warm and dry in the daytime, such as the Rocky mountains of America, or the mountains situated between the tropics, much greater altitudes may be inhabited by residents of the plains. Indeed there is no doubt but that, after a time, in certain climates, the body can accommodate itself to the influence of altitudes much above 10,000 feet.

The results from this long-continued investigation were as follows :—*

1. Persons rising above the sea in the Alps, or in northern latitudes where cold may be considered as increasing with the altitude, expire as a rule a larger amount of carbonic acid as they ascend.

2. In hot countries, near the tropics, such as the Peak of Teneriffe, where cold does not become greater on ascending, or at all events not appreciably to the senses, there is no increase of carbonic acid in relation to height above the sea, the amount of this gas I expired per minute having been nearly exactly the same at every altitude. In the case of my companion, a Swiss guide, the maximum expired was at the lowest station, while at the two highest he expired as nearly as possible the same amount of this gas. The excess given out at the seaside in his case was probably due to an increased amount of food he took at the time.

3. It follows, from the above results, that any increase of carbonic acid expired in the Alps must necessarily be due to the fall of temperature of the atmosphere, and in no way to decreased atmospheric pressure.

4. At altitudes incompatible with the maintenance of the healthy functions of the body, whether this be due to cold or to the actual lightness of the air, or to want of training, the amount of carbonic acid expired within a given time is lessened. This was clearly the case with myself and my young friend during our stay of three days on the Col du Géant, at an altitude of 11,030 feet

5th. At increasing altitudes, whether this be in a cold or hot climate, or whether the altitude be incompatible or not with the healthy maintenance of all the functions, I have found it an invariable rule that less air reduced to seaside pressure and freezing point is expired for the same amount of carbonic acid; or, in other words, the body required the inhalation of a smaller weight of air to produce the same weight of carbonic acid. I can offer only one of the two following explanations to this phenomena :—either as the air becomes lighter, the oxygen finds its way more readily through the substance of the lungs into the blood than under a heavier atmosphere; or else an alteration takes place in the blood under a low atmospheric pressure, increasing in amount that constituent of the blood corpuscles which is known to take up the oxygen of the blood, or "hæmoglobine." Such a change in the blood actually appears to take place after a time at relatively great altitudes, as Mr. Paul

* Proceedings of the Royal Society, 1878, 1879.

Bert has discovered that the blood of animals sent from Mexico, or 7,470 feet above the sea, when shaken with oxygen gas produces much more carbonic acid than that of animals of the same description but living in Paris, which he ascribes to an increase of hæmoglobine. It is impossible, however, to tell how long this constituent of the blood would take to increase from the influence of altitude; generations might be required, or the change might occur in a comparatively short time. It seems hardly possible, however, that the composition of the blood corpuscles should thus alter in a single mountain excursion, and the other alternative, that oxygen in mountain air finds its way into the blood more readily than oxygen in air nearer the seaside because of its lightness, appears to me to account satisfactorily for the phenomenon.

This result goes far to explain the salubrious effects of mountain air, it shows how persons debilitated by fevers, and indeed most diseases, recover their health in a very short time on a mountain station, and how invalids, with a portion of their lungs incapacitated to do its work, can obtain in mountain stations the amount of oxygen their body requires for the restoration and maintenance of health. It also explains how climbers can reach such altitudes as 21,000 or 22,000 feet, although they should have to breathe air extremely rarefied: this rarefied air yielding its oxygen to the blood much more readily than air under a higher pressure.

On "The Valley of the Soar," by JOHN D. PAUL, F.G.S.

IF we wish to study any large tract of country from a sanitary point of view, we must abandon its division into parishes and counties, and look at it as a collection of river basins. The quantity and quality of the surface and underground waters in these basins, the nature of the soil and of the beds beneath it, and the elevation of the surface above the sea, are all powerful influences for good or bad upon the health of the inhabitants. Your Committee have decided that this section might with advantage devote a few minutes to the study of the river valley in which we find ourselves to-day.

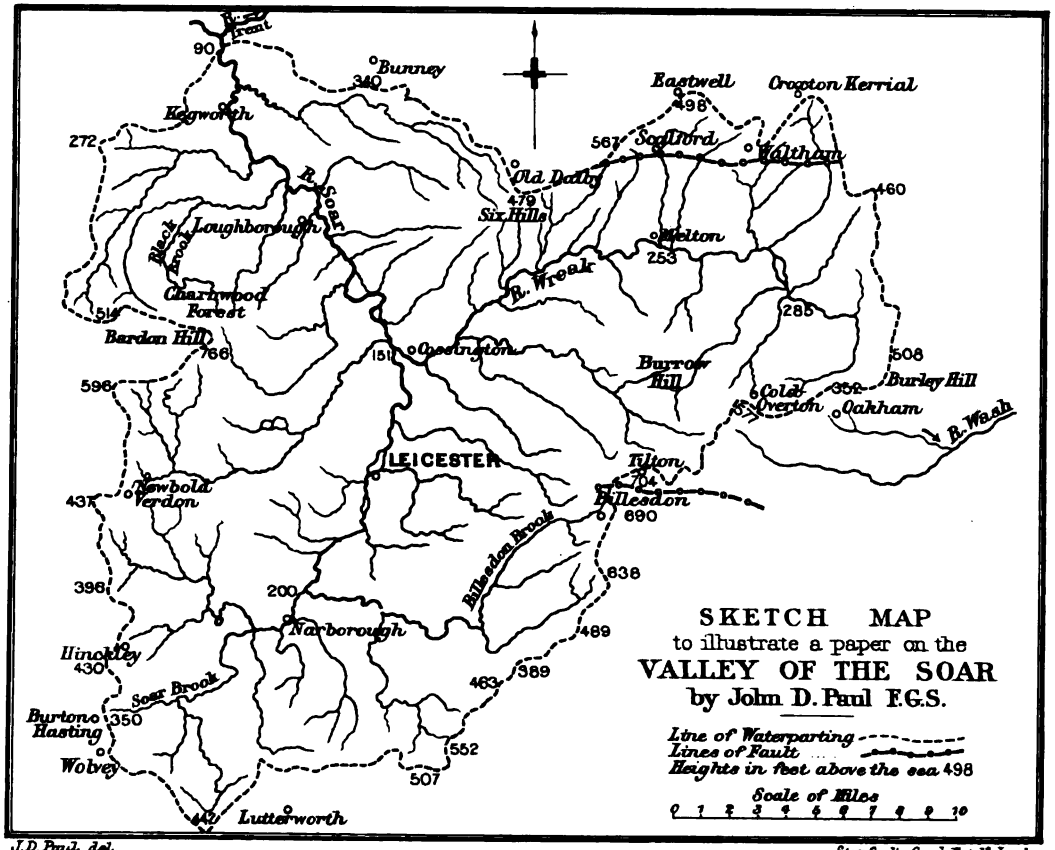
The river Soar,* from its junction with the Trent at Kegworth, measures in length about 34 miles, and drains an area of about 550 square miles. It flows through the middle of the valley, and at Cossington receives its only important tributary, the Wreak. If we follow the course of the river from its junction with the Trent down to Narborough, and then pass south to Lutterworth, we shall find that on the west of this line the surface is composed of Keuper Marls, except where the rocks of Charnwood Forest rise in a miniature mountain chain; whilst to the east we have first a narrow strip of Rhœtics, and then the Lower Lias Clays reach to the margin of the valley. All the beds dip gently towards the south-east. A small coalfield lies beneath the Keuper, south of Charnwood, and extends down to Hinckley, but it has not at present been traced far over the boundary of the valley. The Lower Lias beds yield the excellent Barrow Lime. Along the eastern edge of the valley ironstone is obtained in large quantities from the Marlstone and the Northampton Sand. The Syenites, which break through the flanks of the Forest rocks and crop out as far south as Sapcote, are largely worked for road metal. In the district are found the gypsum of the Upper Keuper Marl, and the brick clays of the drift, a vein of lead ore in the Waterstones, and some traces of tin in a brook on the Forest.

The shape and extent of the valley have been determined:—

First, by the hard boss of the volcanic rocks of Charnwood Forest, which lie to the west of the river at Loughborough. Though these rocks have been considerably lowered by denudation, still no watercourse has been able to cut its way through them.

Secondly, by the ridge we have spoken of before as running along the northern boundary of the valley from Kegworth to Croxton Kerrial, with its backbone of hard Marlstone rock, which has resisted the denuding agents that have excavated the valley of the Trent on one side, and on the other the valley of the Wreak in the softer clays of the Lower Lias. The

* For the derivation of the word Soar, see Fergusson's "River Names of Europe," p. 54:—"There can hardly be a doubt that the words sar, sor, sur, so widely spread in the names of rivers, are to be traced to the Sanscrit sar, scri, to move, to go; sru, to flow; whence saras, water; sarit, srota, river. The Permic and two kindred dialects of the Finnic class have the simple form of sor or sur, a river. France, the Serre joins the Oise. Germany, the Sarre, also the Sure and the Sur. Switzerland, Sare and the Sur. Norway, the Sura. Russia, the Sura joins the Volga, the Svir falls into the Lake Ladoga. Portugal, the Sora joins the Tagus." The origin of the name Wreak is more difficult to trace. The Basque word erreca, a brook, may be connected with a root which has been well-nigh lost, but from which the Irish earc, water, has descended, and of which the Wreak may be another representative.



J.D. Paul, del.

Stanford's Geogl Estab, London

descent of the spur of Marlstone Rock in this ridge to the level of the Lower Lias Clay, is caused by a fault which we can trace for 12 miles along its edge, and this has been one of the main causes that have given to the Soar Valley its present shape. Any one who will examine the map (p. 264) will, I think, admit the great probability that this ridge at one time extended across, by way of Six Hills, Prestwold, and Loughborough, to the Forest. If it did so, one of the first steps towards the formation of the Soar Valley must have been the commencement of a watercourse draining northwards at the foot of the Forest hills. Where we have an elevated rocky district draining towards a more easily denuded country, we usually find a river running near the line of contact of the harder and softer beds, just as we have the Severn flowing at the foot of the Malverns.

Third. Continuing our circuit round the margin of the valley from Croxton Kerrial to Billesdon, we follow the water-parting running along the edge of the escarpment formed by the Marlstone and the Northampton Sand which overlie the thick and easily denuded clays of the Lower Lias. The same escarpment forms the eastern side of the valley of the Severn, and near Cheltenham attains a height of 1,100 feet. It may be traced, varying in importance with the number and thickness of the beds which compose it, across the kingdom from Bristol to the mouth of the Humber. As we stand on its summit by Billesdon, Burrow, or Cold Overton, at a height of about 700 feet, and look across to the Forest, we see the valley of the Soar as an outstretched plain lying several hundred feet beneath us.

We ought not to leave this corner of the valley without noting the very striking breach which occurs in this escarpment at Oakham. It presents an unbroken elevation till we come to Burley Hill which is somewhat over 500 feet high, when for two miles in width an immense gap has been cut through it. If we pass through this gap towards Stamford, we find ourselves in a deep, wide river valley, which must have required the scour of a considerable stream to hollow it out. Now at Oakham there is no river, and between Langham and Burley there is not even a brook, and if we wish to account for the immense amount of work which has obviously been performed, we must suggest some conditions very different to those prevailing at the present time. So far from this requirement placing any difficulty in our path, the explanation we are obliged to suggest is really a very striking confirmation of the history of the formation of the valley which we have been endeavouring to make out. We have spoken of the gradual excavation of the soft, easily denuded Lias Clays, and the consequent ex-

tension of the valley of the Soar eastward up the area at present drained by its tributary, the Wreak. When that process of eastward extension commenced, what is now the valley of the Wreak must have been filled up with a mass of Lias Clay, Marlstone, and Oolite, several hundred feet thick, the surface of which sloped towards the east. Down this slope, past Oakham, flowed the surface water on its way to the sea, cutting the channel of the river Wash between Oakham and Stamford. Every addition to the water of the Soar which reaches it by the Wreak, is just so much robbed from the Wash; and this valley, which is to-day tributary to the Soar, was at one time the gathering ground of the head-waters of a stream which cut the gap at Oakham through the Oolite and Upper Lias Clay down to the Marlstone Rock.

When we leave the floor of the valley and ascend the escarpment we have before referred to as forming the margin of the valley on the east, as for instance at Burley Hill, we pass from the Lower Lias Clays, which are here covered with thick patches of drift, the remains of what was at one time probably a continuous sheet banked up against this rim of the basin, and as we mount the hill we come in succession upon the Middle Lias Clays, the Marlstone Rock bed, the Upper Lias Clay, and last of all we have the capping of Northampton Sand or Ironstone. An advance of a few hundred yards further along this high tableland, brings us upon the Lincolnshire Oolite, which covers the country for some miles to the east. South-west of Oakham this plateau has been subjected to a more active denudation than between Oakham and Croxton Kerrial, and the Lincolnshire Oolite and Northampton Sand have been removed from about thirty square miles of high country lying between Oakham and Tilton-on-the-Hill.

Passing along the escarpment, at Billesdon we meet with a fault which repeats the condition of that we have already referred to as running by Scalford and Waltham. In the same way it brings down the Marlstone to the level of the Lower Lias Clay, and permits the excavation of a valley on its southern side, which in this case is tributary to the Welland, whilst at the same time it forbids the extension of the Soar valley lying to the north. Just before the water parting quits the top of the escarpment, the springs from the Marlstone give rise to the Billesdon brook, one of the secondary tributaries of the Soar. As the water parting sweeps round the southern edge of the valley past Lutterworth, Hinckley, and so on to Newbold Verdon, it descends 200 or 300 feet, and passes over a country, first of Lias Clay and then of Keuper Marl, which is encumbered with masses of drift, sand and gravel, which may

indicate the beach of a glacial sea. The roll of high land which separates the drainage areas of the Anker, the Sence, and the Mease, tributaries of the Trent valley to the west, from the valley of the Soar, has doubtless been preserved by the protection afforded by the Forest Hills against denuding agencies descending from the north.

From these beds of sand and gravel issue the springs which give rise to the minor brooks which come together in about the centre of the valley near Narborough. One of these, called the Soar brook, is entitled to some attention, as it is the source of the river. About two miles south of Hinckley, on the road to Wolvey, at a height of 350 feet above the sea, there is a large patch of eastern drift sand and gravel lying in a pan of retentive clay. It is just outside the county boundary, and formed, years ago, part of the common fields of Burton Hastings, in Warwickshire. Between three mounds, covered with gorse and trees, which may have been ancient burial places, runs a ditch only a few inches wide, but so well supplied with water from the bed of sand that it is overgrown with reeds, which before the enclosure no doubt spread over several acres, and formed a home for snipe and waterfowl. This ditch is the source of the Soar. During its course of ten miles and a half, down to Narborough, it falls at the high rate of 15 feet in every mile; whilst from Narborough to the Trent the gradient is 5 feet to the mile. It is only the comparatively small quantity of water which descends by these brooks in the upper reaches of the Soar that deprives them of considerable denuding power, and so prevents the rapid extension of the valley to the south.

There is a fourth physical feature without which the Soar Valley could never have existed in its present form, and that is the very marked depression which crosses the centre of England, between the southern end of the Pennine Chain and the high ground lying to the north of Charnwood Forest. By this depression the Trent, after draining a large part of the counties of Stafford, Warwick, and Derby, finds its way across the centre of the kingdom: at its junction with the Soar at Kegworth it is only 90 feet above the level of the sea.

Turning our attention now to the interior of the valley, we cannot fail to be struck by the nearly uniform height of the hills on either side of the river; and if we imagine a line reaching from one edge of the basin to the other, touching the tops of the hills, we should find it raised about 300 feet above the level of the sea, over the river Soar, and rising one or two hundred feet higher as it approached the watershed on each side of the valley. The height and slope of this line give us an

indication of the position and the inclination of the floor of the glacial sea, beneath which the valley was submerged. The patches of drift, sometimes 100 feet thick, to which we have so frequently referred, are the remains of the materials which made up this ancient sea bottom. Through this floor of tough glacial clay the water courses, and the river valley have been excavated by the action of rain and weather. We have abundant evidence that after the main features of the valley had been sculptured into very much their present form, that it again descended beneath the waves of a glacial sea, though apparently for a shorter period. Along the eastern side of the valley the junction of the Marlstone Sand and the Northampton Sand with the impervious Lias Clays is marked by a line of springs which has determined the sites of most of the villages on that side. The Lias Clays are almost destitute of underground water, and the villages dotted on their surface derive their supply from patches of the drift. The same may be said of many of the towns and villages on the Trias. As an instance I may refer to Hinckley, where all the wells are sunk in the drift gravel.

An examination of the basin of the Soar shows that there are several areas from which the 150,000 people collected round Leicester in the centre of the valley may draw any further water supply they may require. The Thornton, the Swirthland brooks, and the Blackbrook, which have been already appropriated, are unquestionably the best collecting grounds in the valley, but there are others, such as the Twyford and Billesdon brooks, which might be drawn upon for additional supplies. Unfortunately the underground waters, such as those from the Waterstones, give little promise of a supply suitable for domestic consumption.

There is always an abundant supply of brilliant water ready to burst from beneath the gypsum beds in the Upper Keuper Marls, and this source has been drawn upon in many cases in Leicester by the owners of steam engines for condensing purposes. The water, which is reached at about 30 yards, contains about 100 grains of sulphate of lime and 20 grains of sulphate of magnesia to each gallon. This supply is worthy of more attention than it has hitherto received. In the Waterstones still lower down in the Keuper, is stored up a large supply. At Hinckley the local authorities bored down 750 feet through the gypsum beds and the saliferous marls to the Waterstones, with the result that they obtained an ample supply of water, which contained 650 grains of solids to the gallon, consisting of 340 grains of sodium sulphate, 163 of calcium sulphate, and 101 of sodium chloride, with 31 of carbonate, and 11½ of sulphate of magnesia.

Turning our attention now to the river itself, I find that the water is of a better quality than one might expect. Dr. Emmerson, the County Analyst, has kindly furnished me with some particulars of a sample recently taken, after a period of comparatively dry weather, from below the Bow Bridge. It contains 49·5 grains of solids to the gallon, chiefly carbonate of lime, with some sulphates, whilst the amount of free and albuminoid ammonia only amounts to one-hundredth part of a grain. The hardness is 8½ degrees.

The river has excavated for itself a wide valley in the Upper Keuper Marls, and beneath the meadows on either side of the present channel we have a regular series of deposits. Lying in a pan of hard Keuper Marl we have first a varying thickness of rolled gravel, doubtless the remains of the mass which has been removed in the formation of the valley, the marl and sand having been washed away by running water, and the stones left behind in the bed of the stream. On the top of this gravel we find several feet of clay, brought down into the valley by freshets from the Keuper and Lias Clays on either side. Upon this grew the trees whose stumps are still embedded in it, and also the water plants and mosses which formed a thick bed of peat. The peat is buried beneath layers of clay which gradually rose above the water and formed the surface of the meadows. In the gravel we find abundant remains of the Mammoth and those Arctic animals usually associated with it, but we have as yet found very few traces of pre-historic man. When he first reached the banks of the Soar, he no doubt found its basin covered, as it was for centuries afterwards, with thick woods. The great changes which have been produced in its appearance since that time have been the result of clearing, drainage, cultivation, and the settlement of a dense population.

Dr. W. Marcet, M.D., F.R.S. (London), considered Mr. Paul had contributed an important page to the geological history of the country, and suggested that the damp clay soil of Leicester might have something to do with the prevalence of infantile diarrhœa and consumption. He congratulated the inhabitants of the town on possessing a supply of good water.

Mr. F. T. Mott (Leicester) disagreed from Mr. Paul as to the probable original height of the Cherwood range. Surely it must in Palæozoic times have been very much more than double its present height to account for the geological phenomena of the district.

Mr. G. J. SYMONS, F.R.S. (London), pointed out that Leicestershire was within measurable distance of the dryest part of England. He welcomed the paper because it dealt with the river basin. When the natural divisions of a country were considered as indicated by the river basins, questions of river pollution would be more easily settled. The multitude of different divisions in this country would be incredible if not true. There were political, legal, ecclesiastical, registration, county, parish, hundreds, poor law, sanitary, urban, rural, water supply, gas supply, and, in fact, almost innumerable divisions, interlaced and overlapping, and more complicated than any Chinese puzzle. The sooner common sense prevailed, and river basins were adopted, the better.

On "A recent Legal Decision, of importance in connection with Water Supply from Wells," by W. WHITAKER, B.A., F.G.S., Assoc.Inst.C.E., Assoc. Mem. Soc. Med. Officers of Health.

NEARLY 40 years ago two deep wells (with borings) were made at Brentford, which, passing through Gravel, London Clay, and the Lower London Tertiaries, reached the Chalk at a depth of about 315 feet, and were carried some way into it.

One of these wells is at the Brewery on the southern side of the High Street, now known as the Royal Brewery, and it continued in use till its water became unfit for brewing-purposes, from the cause noted below. The other is 99 yards off, north-eastward, at some printing-works at the back of the houses on the other side of the street. This one was made for a Distillery which has long ceased to exist; the well too has been abandoned, at least for its original purpose of water-supply.

Unfortunately, however, some years ago (between 1874 and 1882) the Distillery well, as we may call it, was turned to a baser use, being made into a cess-pit, by turning it into the drainage of the privy belonging to the printing-works. This misuse has ceased for some three years; but not before a considerable deposit had been formed in the well.

The water of the Brewery well, once of good quality, having been found to have become gradually contaminated, the owner, Mr. M. Ballard, sought to discover the cause, and, the misuse of the Distillery well having come to his ears, he was led to

attribute to that the falling off in quality of his own well-water, the use of which was at once discontinued.

This led to his bringing an action against the owner of the Distillery well, Mr. Tomlinson, for heavy damages, and, although the misuse of that well was then stopped, of course its effects on the water of the Brewery well did not cease, and were not likely to for some time. Having, in the course of the proceedings, been consulted on the Plaintiff's behalf, I may be allowed to call public attention to the importance of the question at issue.

That the two wells get their water from one common source, the Chalk (and perhaps, to some extent, from the overlying sands), is incontestable. When no pumping goes on at either, the water level is the same at both, about 27ft. down in the Brewery well and 37ft. in the other, the site of which is some 10ft. higher.

Practical evidence, however, of the communication between the two was given by the Brewery well being pumped for 48 consecutive hours, whereby its water-level was lowered 78ft. 9in., and that of the Distillery well 14ft. In order, moreover, to make assurance doubly sure the lithium-test was applied at the suggestion of Dr. Frankland, and some of the lithium-chloride put into the Distillery well was found to have been drawn to the Brewery well 48 hours afterwards.

The question, therefore, of communication between the two wells could not be disputed; it was clearly a fact, and the Defendant's case was based on purely legal points, which amounted practically to the statement that any man could do as he liked with his own well, a contention which was successful at the trial before Mr. Justice Pearson, in February, 1884.

The judge ruled that, as it had been decided in the well-known case of Chasemore *v.* Richards, that no one had a right to underground water so far as *quantity* is concerned, or in other words that neither Plaintiff nor Defendant could be restrained from pumping each other's wells dry, or from carrying out works that might take away each other's supply, so also there was no right in *quality;* but that the Plaintiff, whilst having a perfect right to pump as much water as he liked, so as to draw away water from the Defendant's well, must take that water subject to everything that has occurred to it. If he did not pump up the water from his own well he would not get the bad water from the neighbourhood of the Defendant's well. I must own that to my unlegal mind the idea of having a well without pumping water from it was somewhat amusing, and I was inclined to infer that if it had been a case of an overflowing well, from which the water was delivered by the natural force

of gravity, instead of by the artificial force of a pump, the decision might have been different, though why I do not see.

In his decision the judge seems to have been somewhat influenced by the possibility that, if the law were otherwise, actions might ensue for like pollutions at great distances, instead of the trifle of 100 yards as in this case, and, in his judgment, he imagines a series of litigants spreading the grounds for such an action over a distance of 60 miles. Though to a lawyer this may seem an inconvenient prospect, I think that sanitarians may be inclined to look on it with no disfavour.

The result of such a judgment amounts of course to saying that no underground water-supply is safe from contamination, even if wilfully brought about. Should your neighbour have a well with a good supply, and you wish to spite him, or to spoil his business, all that is needful would be to put down a bore to the source of supply, and to pour some poison down it! This matter, I believe, was noticed by one of the Plaintiff's counsel. Perhaps, however, in such a case, or in one where sewage containing typhoid or choleraic evacuations was knowingly poured into a well, so as to foul a neighbouring one, the offender might be convicted of manslaughter, in a criminal case, though (under Mr. Justice Pearson's judgment) he would get the best of a merely civil action! This would certainly be a somewhat anomalous state of things, even as regards English law!

So many towns, institutions, and manufactories now get their water-supply by wells in the Chalk, and in other great water-bearing beds, that the result of such a judgment passing unchallenged would have been most serious. It would possibly indeed have been a great check to enterprise in that direction, as water thus got, perhaps at great expense, might at any time be made worse than that got from streams which are more or less contaminated.

The Plaintiff, however, was advised to take the case to the Court of Appeal, and all folk interested in the getting of pure water should thank the Master of the Rolls, and the Lords Justices Cotton and Lindley, for unanimously overruling the judgment of the court below, as they did in February, 1885.

The Master of the Rolls holds that "although nobody has any property in the common reservoir or source [of underground water], yet everybody has a right to appropriate it in its natural state, and no one of those who have a right to appropriate it has a right to contaminate that natural source so as to prevent his neighbour from having the full value of his right of appropriation;" and he goes on to say, in answer to an objection that the water is got by artificial means (pumping), that "however he [the Plaintiff] may appropriate the water from the common

source, he has a right to have that common source uncontaminated by any act of any other person." With regard too, to the question of distance, his judgment is equally satisfactory; for he says that "the question does not depend upon the parties being what is called contiguous neighbours. If it can be shown in fact that the Defendant has . . . fouled . . . . the common source, it signifies not how far the Plaintiff is from him."

Lord Justice Cotton draws attention to the fact that the Defendant was not using the water from his well, but only putting filth down the well, which does not amount to using a natural right, and by so doing, he "interferes with the exercise by the Plaintiff of a natural right incident to the ownership of his own land."

Lord Justice Lindley remarks that the case "really involves the question whether a person who has a well on his own land is at liberty to poison the water which supplies that well and a large district round about it. The defendant says he has such a right. It is a startling proposition to say the least of it." He adds that "the right to foul water is not the same as the right to get it. . . . *Prima facie* no man has a right to use his own land in such a way as to be a nuisance to his neighbour. . . . If a man chooses to poison his own well, he must take care not to poison waters which other persons have a right to use as much as himself. . . . The right of a man to get water from his well is to get the water as nature supplies it."

As a geologist, much interested in the question of water-supply from underground sources, it was with a feeling of great relief that I heard of the view of this case taken by the Court of Appeal, and I read the full report of the judgments (from which the above quotations have been made) with much pleasure. I am inclined to think, indeed, that Mr. Justice Pearson, albeit he seems to hold strongly to the opinion that this is a free country, may feel relieved rather than grieved at the reversal of his decision. Had it been upheld, there would clearly have been great need of a little law-making.

Although all sanitarians must be glad at the final decision in this case,—for it will not be carried to the House of Lords,—yet it seems unfortunate that the privilege of bringing up so important a matter for settlement should have fallen to individuals instead of to corporations or to companies, on whom the expense would have more fairly fallen. It may be but a poor consolation to both Plaintiff and Defendant, that their names will become famous, like those of Chasemore and Richards, from the case of Ballard *v.* Tomlinson being one that is likely to be quoted for many years, as giving a most important decision in the law of water-supply from wells.

Whilst it was decided, in the earlier case, that every owner has the right to draw underground water to an unlimited extent, the decision now noticed is to the effect that no owner has the right to pollute a source of water-supply common to his own and other wells. Whatever may be the fate of the former decision, it is to be hoped that the latter one will never be altered.

W. MARCET, M.D., F.R.S. (London), thought there was but little to discuss in this paper. The whole question was whether or not a nuisance had been committed. If a nuisance had been committed, the offender was amenable to the law; and he held that just as contamination of water by a neighbour above ground would be ruled as a nuisance, such contamination below ground should be considered in the same light.

Prof. F. S. B. F. DE CHAUMONT, M.D., F.R.S. (Southampton), said it would be interesting to hear from the Town Clerk whether, in his opinion, this decision would enable any person to bring an action against his neighbour for having a porous cssspool which fouls the earth and probably the water.

Captain DOUGLAS GALTON, R.E., C.B., F.R.S. (London), observed that at Gravesend the people had long been in the habit of making excavations in the chalk for cesspits. The advantage of the system was said to be that they never needed cleaning out; but after this had been going on for fifty years, it was now discovered that injury was being done to the water supply.

On "Hygienic Analysis," by CHARLES E. CASSAL, F.I.C.Exam., F.C.S., Public Analyst for Kensington, Senior Demonstrator, Department of Hygiene, University College.

THE relation of the public analyst to the public health is as yet but imperfectly understood. People have a vague kind of idea that there are such persons as public analysts in existence, and that the magnitude of the fees to be paid to them for "analysing" is out of all proportion to the value of their work, considering the extreme ease with which they ought to be able

to tell at a glance the exact composition of any and everything that may be submitted to them. And it is not the general public only, for numbers even of those who have had some sort of scientific teaching are very much at sea as to what the public analyst can and ought to do; while there are others who, because at one time they have had a three months' more or less imperfect course of teacing in some laboratory, or in a chemist's shop, consider themselves amply qualified to pronounce upon the purity of water or milk, and to give decisive certificates in other equally important matters. Of this, indeed, there are very numerous instances, especially in regard to water, milk, and to the detection of arsenic in wall papers. Waters are sent to the local chemist—even in London—a man generally possessed of the most hazy ideas of analytical chemistry in general, and no ideas whatever on water analysis in particular; or, again, they may be sent to the doctor. In some cases the chemist and the doctor know enough to send the samples on to an analyst of repute, with some pretension to the title of chemist; in some rare instances they know enough by practice and experience to make a fairly satisfactory analysis, and to give a proper report themselves; in others they proceed to "examine" the water, and give a report, when they are totally unqualified in every way to do so. I know of instances in which a water, having been thus examined, a report has been received as follows:—"This water is one of second-rate quality;" and again, "This water may produce typhoid fever"—fee, two guineas. The number of instances in which waters are passed as fit for use on utterly insufficient evidence is very great, and has served largely to bring discredit upon water analysis and water analysts, who in this respect suffer to a great extent for the sins of those who are utterly unfit to deal with the subject. Again, with regard to milk: the lactometer, a most misleading instrument, is used by milkmen to demonstrate the undoctored condition of their commodity, and is believed in by the public. It is used by the wary householder when he imagines that there is a suspicious blueness or want of richness about his milk—an apparent want of richness which not unfrequently occurs when the milkman has not put enough annatto into the sample to give it a slight yellowish tint, and it is used by the amateur analyst as the experiment on which to base his report. With regard to the testing of wall papers and other materials for arsenic, mistakes are extremely common when the work is undertaken by the unqualified, some care and judgment being required, and especially great purity of chemicals: papers perfectly free from arsenic being reported as "highly arsenical," and arsenical papers being franked as perfectly safe.

The fact is, that the delicate processes of analytical chemistry should never be undertaken by those who have not had a full and thorough training, and who cannot show that this has been the case. The title "Public Analyst" is very properly restricted by law to those only who hold a public appointment under the Act, although it is unjustifiably used by others. Analyses should no more be undertaken by the partially trained than cases of disease should be treated by quacks. I have no sympathy whatever with those excellent people who are so anxious that the public at large should test their water, milk, bread, butter, coffee, wine, wall papers, and all the rest for themselves, for while positive results may be valuable, negative ones—which are the more frequent—simply produce a most dangerous state of false security.

Under the provisions of the Sale of Food and Drugs Act, 1875, the public analyst, in his official capacity, is concerned merely with the examination of food and drugs, water analysis and poison cases not being included. On the continent somewhat better provision is made in this respect. For instance, soaps of improper composition, papers, and other articles containing poisonous colouring matters, and patent medicines, are liable to seizure and to condemnation, and their vendors to punishment.

Hygienic Analysis comprises the examination by chemical, microscopical, and other means, of all articles which may have some direct or indirect bearing on health. The analysis of water and sewage, of air, of food, of constructive and decorative materials, of clothing materials, of various soils, and the examination of filters and the so-called—falsely so-called—"disinfectants," forms the principal part of such work, and there can, I think, be no doubt that legislation is urgently required to place as *many* articles as possible under the same conditions as those obtaining in regard to food and drugs; that is, that they shall be made liable to seizure and to examination by the public analyst; and I should like, by the way, to state my conviction that no sanitary inspection of a house or place can be considered satisfactory or complete without an analytical examination of the water supply, of wall papers, of paints, and so on.

It is well known that since the passing of the Public Health Act, and the Sale of Food and Drugs Act, the adulteration of food has largely decreased, in spite of all the legal quibbles which have been used to enable defendants to evade the law—in spite of the fact that the use made of the Act has been so restricted through the wilful apathy of so many interested local authorities—and in spite of the absurdly inadequate punishments inflicted for proved offences. Adulteration has de-

creased, but it is still enormously extensive, and the adulterators are becoming more scientific every day. The condition of things in a town where the authorities make the Act a dead letter, would, if revealed, be highly interesting to the inhabitants, at any rate to those inhabitants who were sufficiently intelligent. The smallness of the fines which are as a rule inflicted is a direct incentive to adulteration. Where is the use of fining a man who has sold milk adulterated with 20 or 30 per cent. of water such sums as 10s. or £1? But this will no doubt continue to be the case until people generally, and, ultimately magistrates, succeed in comprehending that such a thing as milk adulteration is not merely a mild fraud, but is a direct attack upon the health, and, in the case of young children, even the lives of the community.

As regards the hygienic analysis of air, the knowledge of the normal condition of the air of a town, a large institution, or a factory, is evidently a matter of great importance, and the hygienic analysis of air, when properly carried out, is quite capable of coping with the problem. But it is a decidedly delicate matter, and requires time and trouble to obtain definite and valuable results. The various easy tests proposed, such as the household test for excess of carbonic acid devised by Dr. Angus Smith, and the graduation of the stuffiness of a place by an educated nose, have not in reality a very extended use, nor are they capable of invariably yielding certain and satisfactory results, although in exceptional cases they are no doubt valuable. The analysis of air for sanitary purposes is only really valuable when it is carried out by specially skilled hands, and with proper and complete apparatus, the chief points in the analysis, the determination of the exact quantity of carbonic acid present, the increase of this gas being proportional to the degree of foul organic pollution, and forming the easiest and most certain measure of the latter in the present state of our knowledge; and the microscopic examination of the sediment obtained by passing a large quantity of the air through an apparatus, whereby the suspended matters are caught in a drop of glycerine on a glass slide, or by some such means, are processes which require great care and numerous precautions.

Water analysis for sanitary purposes is a subject upon which there exists a most extraordinary amount of misconception. There are a great number of fallacies current upon it, not merely in the public mind, but even among those who are professionally engaged in the making of analyses. It is one of the sanitarian's most valuable weapons when it is properly carried out, but it is a source of danger when this is not done. Many people are foolish enough to think that when a water has been

"analysed" it has thereby received a kind of insurance against subsequent pollution, and there are others who imagine that sanitary scientists are all wrong about water, that the drinking of sewage is rather beneficial than otherwise, and that therefore the sanitary analysis of water, like many other sanitary things, is *de trop*. I am acquainted with a country general practitioner of the old school, who was the happy proprietor of a well, the water of which was grossly polluted by a cesspool placed, as is usually the case, close to the well. That water contained as much as 20 grains of chlorine in the gallon, derived almost entirely from sewage pollution. He was in the habit of making up the mixtures for his patients with this water, and used to say that they thrived on it well. What can you expect from the public when such notions exist among professional men?

It has been of late very frequently remarked by some professional journals that water analysis, as at present practised, is "no use" when the question of infection is under consideration. No greater fallacy exists. Water analyses, when they are complete, are perfectly capable of dealing with all probable cases. Partial analyses are worse than useless; and people who work by rule of thumb, and those who form their opinions upon the determination of any single constituent of a water—as many still unfortunately do—are those who bring discredit upon water analysis, and make such statements as those above quoted possible.

It is chiefly on the authority of a report of some experiments carried out under the auspices of the Local Government Board, and published in the 11th annual report of the medical officer, that such statements are made by those who are evidently incapable of understanding the experiments in question, and especially the tremendous fallacies which underlie them, and the utterly erroneous conclusions drawn from them. It must certainly be admitted that cases might occur where infective matter was present in a water to such a small extent as to be beyond the reach of any analytical process; but I altogether deny that there are any *proved* cases of the kind on record, and I contend that no case whatever can be cited where a water having, on undoubted evidence, produced disease has on a subsequent *thorough* analysis been reported as pure. There is a criticism on the report above referred to in last year's transactions of the Medical Officers of Health Society, by my friend Dr. Whitelegge, the Medical Officer of Health for Nottingham, and myself, and we shall be glad to find these criticisms combated by those who uphold the opposite view. This has not yet been done.

In connection with milk analysis, I should like to point out the desirability of the making of full analyses by competent persons. No analysis can be considered satisfactory unless quantitative determinations of the total solid matter, the fat, the ash, and also a microscopic examination have been made. I have just recently seen in a well-known and most valuable journal a short paragraph on milk adulteration, which commences by saying that "to distinguish between the water of the milk and that added to it by the milkman is a problem hitherto unsolved;" the paragraph then goes on to give an account of a test proposed by a Mr. Uffelmann, which is based on a reaction for nitrates, which will be successful with "two drops of ordinary drinking water." This gentleman considers that if he obtains his reaction it is a proof of adulteration (!); and, to quote again, "that we here have a positive evidence," because nitrates, according to him, are present in some proportion in nearly all waters. I mention this paragraph, bristling as it does with the most palpable absurdities, as a further instance of the ignorance that prevails, and the nonsense that is published on hygienic analysis, in quarters whence one might expect better things.

If the time at my disposal, or the scope of this paper permitted, it would be easy to point out still more fully how direct is the bearing of properly conducted analytical work on the public health. In a recent case where I certified a sample of mustard to be adulterated with 25 per cent. of flour and some turmeric, an inquiry was made as to how much flour I would allow in mustard—apparently with the idea that mustard and flour ought to be sold together, and evidently without any notion that even here there is a danger. It may seem absurd at first sight to some, though surely not to any in this audience, but such things as mustard plaisters are frequently wanted in cases of emergency, and the result is not likely to be satisfactory if, instead of a mustard blister you simply apply a mass of dough. Pepper, again, is an article which has been subjected to the grossest adulteration—especially black pepper. If I find a black pepper to contain much more than 7 per cent. of total mineral matter I advise a prosecution. The defence set up as a rule is that the pepper has been kept in a bag or drawer, and that in course of time the adhering mineral matter—clay and sand—have been shaken down. This, of course, is negligence, and the public must be protected for obvious reasons from buying and eating clay and sand instead of pepper. Although the actual quantity taken is small, it is easy to show that small amounts may play a very great part in the health of the individual. Instances might be multiplied. I would merely just mention

two more, viz., those furnished by the so-called "disinfectants" and by the "dyes" used for clothing. The greatest ignorance again prevails about these matters. As regards the former the public are deluded by lying advertisements as to the value of various nostrums for disinfection; and as to the dyes, cheap clothing, and, for the matter of that, dear clothing too, is loaded with dyes that are not *fast*—which evaporate easily by the warmth of the body, and to the deleterious effects of which there are many persons who are peculiarly susceptible.

In the district of Kensington the minimum number of samples to be examined per annum by the Public Analyst, was recently fixed at 500, and the local authority is most anxious to apply the Act as its framers intended that it should be applied. I venture to express the hope that more local authorities throughout the country may, before long, be imbued with some such spirit as this—that they will understand that it is their duty to apply the Acts for the prevention of adulteration to their fullest extent, and, indeed, to demand an extension of legislation to apply to those articles which are at present untouched by the public analyst, in the interests of the communities which they serve and of the public at large.

Dr. W. Marcet, F.R.S. (London), urged the importance, in cases of doubt, of having a thorough analysis of water, including its examination for bacilli, made by a capable analyst, and instanced the experience of the town of Geneva, where such examination and the subsequent steps taken had so far checked the recurrence of epidemics of typhoid fever.

Mr. F. T. Mott (Leicester) said there was no doubt as to the importance of analysis for the detection of food adulteration, but contended that there should be a limit to legislation in this direction. By too much protection of this sort the people might become intellectually pauperized, and neglect altogether to exercise their own common sense. The law should protect the public against any injurious adulteration, and against adulteration which ordinary common sense could not detect; in all other respects they should be left to judge for themselves. Some people liked potatoe flour in bread. Mustard adulterated with flour was not injurious, and anyone could tell whether sugar was adulterated with sand.

Capt. Douglas Galton, C.B., F.R.S. (London), thought very few would agree with the last speaker. What they contended for

was that the public should know whether they were getting the genuine article or an adulterated imitation. He fully agreed with Mr. Cassal as to the uselessness of incomplete water analyses, many of which were misleading and absurd.

Dr. B. A. WHITELEGGE (Nottingham) pointed out that private individuals presented very few articles for examination by the Public Analyst under the Act, which seemed to be very little known to the general public. Analyses of adulterated foods were almost always made at the instance of the public authorities. It would be very difficult to draw the line, as suggested, between adulterations which were injurious and those which were not. In most cases the penalty was to be regarded as inflicted on account of the fraud, not of any definite injury to the consumer. Since the number of samples taken of any article must necessarily be few, it was clearly the duty of the magistrate to impose substantial penalties where adulteration was proved, in order to act as a deterrent to others. Unfortunately this was not always the case. It would be interesting to watch the Parisian experiment of allowing the public to bring articles to the Municipal Laboratory for analysis.

Mr. G. J. SYMONS, F.R.S. (London), said there was another Parisian practice he should like to see adopted in this country. In any case where adulteration was detected, the offending trader was not only condemned to the payment of a heavy fine, but was bound to put a placard about a foot and a half square in his shop window, announcing what he had been doing and what punishment had been inflicted.

Alderman PAGET (Leicester) said the practice of the Sanitary Committee in Leicester for water analysis was as follows: An analysis was made of the water obtained from the wells sunk outside the town, free from any possible sewage contamination, and therefore presenting the natural qualities of the unpolluted water of the district. This analysis is taken as a standard with which an analysis of the water from a suspected well is compared; and the amount of pollution shown to exist determines whether or not the well should be closed.

Mr. C. E. CASSAL (London), in reply, said no analyst was in a position to report on the quality of water until he had made as complete an analysis as possible, together with a careful microscopical examination. In a Sanitary Congress he should have thought it unnecessary to insist upon the desirability of not allowing adulterated articles to be sold. The amount of information a man would obtain by the exercise of "ordinary common sense," would be very small indeed in the examination of food or of anything else. Taking the case of sugar and sand for example, as it had been alluded to—although the

sanding of sugar was a thing of the past—it was quite possible that a person might detect the presence of fifty per cent. of sand in sugar by means of his "ordinary common sense," but he would be utterly unable to detect five per cent., without some knowledge of analytical methods. The adulteration of mustard with flour became a very serious thing in the case of a mustard plaister suddenly required, and might involve the balance of life or death. Milk adulterated with water, or deprived of a portion of its fat, was highly injurious to children—and it should be remembered that the water used for adulteration was not always clean—and that in consequence such milk had been the cause of outbreaks of disease over and over again. It was to be deeply regretted that those who were charged with the administration of the law did not seem to understand that milk adulteration was not a mild offence, but was in reality a serious crime, and should be punished with great severity. The fines inflicted were absurdly inadequate. A fine of £50 was not at all too great for putting say 20 per cent. of water in milk, and when a person had been convicted more than once, a term of imprisonment, without the option of a fine, should be inflicted.

Not only was a much greater extension of the Act absolutely required, but it was necessary that local authorities generally should appreciate their duty to those whom they represented better than they did at present: by the appointment of duly qualified analysts, by taking care that a large number of samples should be seized and analyzed, and that prosecutions should be instituted and carried through; for at the present time, except in rare instances, the Act was not properly carried out—being, in fact, in most places, practically a dead letter, and the public were not protected as they should be.

On "The use of Sodium Aluminate for Softening and Purifying hard and impure Water, Deodorising and precipitating Sewage, waste water from factories, &c., by F. MAXWELL LYTE, F.C.S., F.I.C.

ACCORDING to Roscoe, the formula for the above salt is $Na_2 Al_2 O_4$ (atomic weight 165) and although other authorities give different formulæ, that of Roscoe may be assumed to be correct, as this formula also agrees with the percentage composition of the soluble portion of the salt given by Unverdorben and others.

Where in solution, even in distilled water, it has a tendency to lose alumina, and approach to the composition $Na_2 Al_4 O_9$. Sodium Aluminate is further decomposed by many neutral salts, acids, and acid salts; forming, in the former case, insoluble aluminates, and in the latter, aluminium hydroxide. As an example of the first may be cited the following:—$Na_2 Al_2 O_4 + Ca SO_4 = Ca Al_2 O_4 + Na_2 SO_4$. I have followed Roscoe's notation, though from the reasons above stated, the other formula is perhaps a better practical guide to work by. I find the Sodium Silicate which crude aluminate contains is also of use, being decomposed, and its soda acting like $Na_2 O$, while the Silica is precipitated with the lime. In this case, not only is the permanent hardness due to the $Ca SO_4$ or other earthy salt destroyed, but if the water also contains temporary hardness, the calcium aluminate may be decomposed, with formation of calcium carbonate and aluminium hydroxide, which latter may take up much of the organic matter, if any be present. Water may thus at one and the same time be freed from—

(*a*) Permanent hardness.

(*b*) Temporary hardness.

(*c*) Organic impurity, leaving in solution only Sodium Sulphate in such minute quantities as to be tasteless, harmless to health, and incapable of affecting even the most delicate colours. The time required for the complete precipitation of the aluminate varies in different waters from a few minutes to several hours. In many cases it is therefore advisable to use some kind of mechanical filter or a subsidence machine, such as the "Stanhope" purifier. The decomposition of the insoluble aluminate is slow, and the setting free aluminium hydroxide only takes place gradually unless frequent agitation be applied; where then the water is temporarily hard, or is contaminated with much organic matter, where time is an object or where it is desired to retain unaltered any hardness it may possess, so as not to cause it to become "flat," the former process may be supplemented by the use of sodium aluminate conjoined with aluminium sulphate, as shown by the following equation:— $3 Na_2 Al_2 O_4 + Al_2 (SO_4)_3 18 H_2O = 3 Na_2 SO_4 + 4 Al_2 (HO)_6 + 6 H_2O$. This formula is very applicable to the purification of sewage, waste waters from factories, &c., and it shows considerable economy on any other mode of producing a precipitate of a given amount of alumina. Its advantages consist:—

1. In its economy over any other process for precipitation by the aluminium hydroxide, and

2. In the comparatively harmless nature and small quantity of the salt left in solution.

The usual way of obtaining the hydroxide is by aluminium sulphate and lime, or chalk. But the sulphate contains, even when pure, only 15·44°/₀ of alumina (the commercial salt 2 per cent. less), whereas the sodium aluminate contains from 52½ to 62½°/₀ (the crude aluminate 33 to 40°/₀), so that a very much smaller quantity of the latter will suffice to produce a given quantity of the hydroxide. Again, by using the sulphate with a base of any kind (other than aluminate) the quantity of salt left behind will be greatly increased, and if lime or chalk be used, it will give to the water permanent hardness. With regard to the question of cost. Sodium aluminate has never been manufactured in England on a large scale, so that its price is at present abnormally high, although there is reason to believe that it may before long fall considerably.

As it is, water can be freed from 10° of hardness, as well as from organic matter for 1d. to 2d. per 1000 gallons. Practically, and using the crude salt now obtainable, 1 grain per gallon may be said to destroy 1° of hardness.

NOTE.—The 2nd, 3rd, 4th, and 5th paragraphs have been slightly altered, at the Author's request, to put the chemical reactions in harmony with what really takes place, but the final result is the same and continues unchanged.

On "The Danger to Health arising from Burial in Imperishable Coffins," by the Rev. F. LAWRENCE, Vicar of Westow, Hon. Sec. Church of England Funeral Reform Association.

AMONG the evils arising from our ordinary mode of disposing of the dead is that of keeping as long as possible that which ought to be buried as soon as possible. The magnitude of this evil is known only to persons who move among those whose dwelling-place consists of one room. The obvious remedy is the provision of mortuaries attached to every burial-place. But a greater evil exists in improperly burying the body in an imperishable coffin, preventing dissolution, and storing up human remains in every stage and condition of decay. The *Lancet*, in an article headed "A Serious Peril to Health," alludes to certain burial-places as a source of peril, both to those who officiate therein and to those who dwell in the neigh-

bourhood, while Sir Lyon Playfair, the President of the British Association, in speaking of the soils of burial grounds, says, "they are often saturated and supersaturated with animal decomposition," and adds, "I have inspected many churchyards and made reports on their state, which even to re-read makes me shudder." What churchyards have been, cemeteries will be, if this evasive and unnatural method of burial continues to be observed. For bodies to be properly resolved they must be buried in such a way that the earth may have access to them. The burying of bodies in solid coffins is simply heaping up that which destroys the soil, fouls the air, contaminates the water-springs, and spreads the seeds of disease. It is a mistake to suppose that wood decays in the earth. The coffins which were buried more than 200 years ago in the Holborn Burial Ground, were found recently just as they were buried, with their contents in such a condition as to defy description, while the surface had been raised sixteen feet by this mass of arrested and aggravated decomposition. No wonder that this accumulation in our midst of vast masses of human remains, generating poisonous fluids and gases, should have suggested cremation as the better mode of disposing of the dead. But three objections present themselves. Cremation ignores the fact that the earth is the most powerful disinfectant known, and is the natural destination of all creatures that have lived and then died. Cremation necessitates in every case a post-mortem examination, which will be costly, which will often be perfunctory and ineffectual, and which of a certainty will pain the relatives. Cremation facilitates secret poisoning, the evidence of which can be found only in the body. Yet if the dead were properly buried, the evils now most justly complained of would not exist, and the requirements of right feeling and science would be satisfied. The Church's "Order for the Burial of the Dead" provides such. Her use of the words "corpse," "body," "earth to earth," implies burial in the simplest, most speedily perishable coffin in the simple earth. As the *Lancet* put it, in the article already referred to, "the coffin should be constructed, not with a view to its endurance, but to its perishability." This is indeed a better, because more natural, form of cremation, called by Liebig, *Eremacausis*, slow cremation, the earth being in this case the crematory. The body is buried in its own grave, in well-drained, dry, and porous soil, and there undergoes, not mere decay, but a process of transformation. The earth, as earth, does not affect the body, but acts as the porous medium between it and the air above. Through this superincumbent earth the air descends and resolves the body into new and harmless products, carbonic acid and ammonia, which pass upwards in

air; and this process continues for three or four years, until at last the body has, in a lower and more immediate way, literally risen again and become the source of new life, leaving behind it nothing but inorganic matter, and in a few years after the burial the same earth is ready to perform the same beneficent action again. The well-defined laws of nature have been observed, and sanitary evils avoided.

Dr. W. Marcet, F.R.S. (London), said that earth was no doubt a very efficient disinfectant. But they must not forget Mr. Darwin's famous paper on the influence of worms bringing to the surface of the earth organic matter undergoing decomposition at various depths.

Mr. H. P. Boulnois, M.Inst.C.E. (Portsmouth), maintained that pollution of the earth must take place wherever dead bodies were placed beneath the surface. The gases emanating therefrom passed into the air, whether the decomposition was a rapid or a slow process. There were many cases in which drainage from burial grounds polluted the streams, and he had heard of a case in which cattle were poisoned in consequence. From a sentimental point of view, he had a great horror of the idea of a person slowly decomposing in the earth. When the spirit had left the body, all that was dear to surviving friends was gone, and he considered it would be far better to at once place the corpse in fire, the most purifying agent known. How long a body would remain in a burial ground was nowadays uncertain; Land was wanted for a railroad, for a new road, or for an improvement of some kind, and forthwith the burial ground was destroyed, and the graves desecrated.

Mr. F. T. Mott (Leicester) admitted that the present system of burial was exceedingly defective. The question was how to improve upon it without outraging the feelings of the living, and without creating any new form of nuisance. Theoretically, there was much to be said for cremation, but it would take many years before the majority could be persuaded to allow beloved forms to be cast into the fire and burnt up. Burial in perishable coffins in porous and well-drained soils, with no fresh interment to take place in the same grave until after the expiration of ten years, would be a great improvement. He should like to ask whether Mr. Lawrence proposed to allow such an interval to elapse, and also whether under his system the bones would disappear as well as the softer parts of the human frame.

Mr. J. B. Everard (Leicester) said the decomposition going on in

St. Pancras Churchyard, which he noticed while engaged upon some operations there in connection with the Midland Railway extension to London, some years ago, fully convinced him that something must be done to improve the present system of burial. He thought that England was not yet prepared for cremation, for reasons which would commend themselves alike to medical men and engineers. Mr. Lawrence's suggestion to some extent met the difficulty.

Captain DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S. (London), said it was a curious fact that in the Franco-German war, in disinfecting some of the battle fields, some very interesting observations were made as to the effect of different soils in assisting the decomposition of bodies. It was found that in chalk bodies disappeared altogether after a year's interment, while in clay they were almost entirely preserved. A large part of England was clay, and there was no doubt, even adopting the plan suggested by Mr. Lawrence, bodies would be preserved for a very long time. The question of cremation in connection with those who died in metropolitan small-pox hospitals, would no doubt come up for consideration on some future occasion. There was one point of the very highest importance not touched upon in the paper, and that was the very grave objection there was to allowing the bodies of the dead to remain amongst the living for so many days, as was the custom in this country. Numerous mortuaries ought to be provided in all towns and villages, and all corpses should be removed into them soon after death, unless the bodies were sealed up in lead coffins.

ALDERMAN KEMPSON (Leicester) remarked that an alteration in the law would be necessary for the enforcement of the removal of corpses to mortuaries. When the Leicester cemetery was first opened a mortuary was provided, but it was so little used that in a few years it was pulled down. Agreeing to the necessity for an improved system of interment, he thought the country was not yet prepared for cremation.

Mr. G. J. SYMONS, F.R.S. (London), pointed out that the condition which had been demanded, viz., that a cemetery should be well-drained, was a serious danger to the water supply. As a supporter of cremation, he had no doubt that if people were only acquainted with what really went on underground in the horrible work of decomposition, they would all become supporters of cremation too. One original argument against cremation was, that it would render impossible the detection of poison in the body in cases where foul play was suspected. The Cremation Society had provided against that, and in cases of doubt held itself free to decline to carry out the process. They already required medical certificates as to the cause of death from more than one medical man.

Dr. B. A. WHITELEGGE (Nottingham) did not attach very great importance to the preservation of the body for a few weeks or months

for the sake of possible medico-legal investigations after interment, but still he did not think that absolute security against foul play could be obtained by means of medical certificates, as suggested. Cases of poisoning, for instance, were of rare occurrence, and as the symptoms often closely resembled those of diseases which occurred daily, it was more than probable that some of the former would escape detection, however vigilant a watch were kept. Burial in solid wooden or leaden coffins certainly needed reform, for the present system was bad, and the proposal to leave burial grounds undrained would only make matters worse. While Mr. Lawrence's plan was a great improvement, and deserved to be warmly supported too much was claimed for it in one respect, viz.: as regards the asserted "disinfection" by earth. In point of fact, earth was a very poor disinfectant indeed, though an excellent deodorizer. It was now generally recognised that, so far from destroying bacteria and their products (which was the true meaning of disinfection), the earth and the subsoil water often played a most important part in the spread of certain diseases by such means. It was said that it was the natural thing to restore the body to the earth, and to utilise again the elements of which it was composed, but the present system of burial scarcely attempted to do either. The question of providing mortuaries was of great importance. They had been established to some extent in Nottingham, but the poor showed great prejudice against them.

The Rev. F. Lawrence (York) in the course of his reply, said that decomposition of human remains would depend very much on the nature of the soil in which they were interred. Legislation should be sought in three particulars. 1st. To limit the period during which a body should remain unburied. 2nd. To render it illegal to place between the body and the earth anything that should retard its dissolution. 3rd. To compel the directors of cemeteries to supply each body with sufficient earth to ensure its speedy dissolution. He did not agree that earth was not a good disinfectant.

Dr. W. Marcet, F.R.S. (London), remarked that the earth successfully absorbed noxious gases, as for example in the case of earth-closets. At the same time there could be no doubt whatever that the body did undergo absolute putrefaction after burial.

THE ESSENTIALS OF LOCAL GOVERNMENT REFORM.

LECTURE TO THE CONGRESS.

By Ernest Hart.

Chairman of the National Health Society.

NEED AND IMPORTANCE OF REFORM.

Local Government Reform not a new cry.

The question of Local Government Reform is now by universal consent looked upon as one of the very first matters to which the new Legislature that we are on the eve of electing will have to bend its energies. To read the comments which are made upon the subject by public men and in the press, one might think that it was a matter that had only just come within the range of "practical politics," and was now for the first time ripe for reform. We have so many things to occupy our attention now-a-days that we are apt to forget the legislative aspirations and struggles of the past. I take leave, therefore, by way of introduction, to remind you that this is no new subject on which I hope to engage your attention to-night. At least seventeen years ago, within my personal political experience, local government was quite as burning a question as it appears likely to become now; and we ardent sanitary reformers of those days were in great hopes of the accomplishment of a thorough and satisfactory settlement of the very difficulties under which the nation is now, as it was then, ignorantly suffering with a kind of fatalistic idea that they are insurmountable. The chaos of local government was felt then, as it is now, to be a primary obstruction to efficient sanitary administration. There are these differences, however, between the state

of affairs at the two periods: that those whom the extravagance and wastefulness of our present local administration affect most immediately and closely will have a far more powerful voice and influence in the forthcoming elections than they had in 1868, and that we have had in the meanwhile a variety of experiments in "boards" of various kinds—sanitary, educational, and what not—which ought to have had some useful lessons for us.

Importance of Local Self-government.

On the importance of local self-government in the abstract, it is unnecessary for me to speak at any length. All constitutional writers agree in considering it as of high political importance. It has indeed been generally recognised as of the essence of our national vigour. Local administration is the distinguishing feature of our government. The theory is, that all that can should be done by local authority, and that public expenditure should be chiefly controlled by those who contribute to it. Whatever concerns the whole nation must be dealt with nationally, while whatever concerns only a district must be dealt with by the district. But local administration has its drawbacks. The spirit of that self-government, which Englishmen have always vindicated to themselves through every developing period of their history, has led to the growth of many discrepancies in their institutions, and to many disconnected and even conflicting laws. Imperfect local administration has been the natural result.

Complications of our present system.

The complications of our present system of local Government are so numerous and tangled that few have had the patience to attempt to unravel them. Every one is agreed that the system wants reform; but the details to be grappled with are so many that the majority find themselves unable to "see the forest for the trees." For example, there are something like 700 Acts of general application which relate to local affairs, starting with the statute *De Officio Coronatoris*, passed in 1275, and ending for the present with the Housing of the Poor Act, 1885. A number of most excellent books have lately been published with the object of enlightening people as to what local government is, and how it is managed. From the authors of all these I have derived most useful hints and suggestions, for which I take the earliest opportunity of making my cordial acknowledgments.* But most of them do not give with the minuteness which is desirable a connected statement of the reforms which are necessary to make local

* These books are, in the order of their publication:—

1. "Local Government in England," by the Hon. George C. Brodrick. One of the Essays published by the Cobden Club, on "Local Government and Taxation

government an efficient machine; and I shall therefore be excused if I address my attention chiefly to the latter point, and taking for granted a knowledge on the part of my auditors of what local government is, dwell with most insistence upon what local government ought to be.

One authority for each district, but only one.

I suppose there are few people who will not agree with John Stuart Mill, that the control of all the business of a locality should be united under one body, and one only.* This is called the "ideal of the reformer;" but I see no valid reason why it should not be carried into effect, save that our methods of legislation are now almost uniformly scrappy and patchy. As has been pithily said in one of the works just referred to:—

"Almost all the failings of the local administration may be traced back to the mode in which it has grown up. Throughout the present century new social wants have been multiplying. Whenever a particular want became so clamorous that it could no longer be ignored, the Legislature provided for it as if it were the only want of society. For almost every new administrative function the Legislature has provided a new area containing a new constituency, who by a new method of election choose candidates who satisfy a new qualification, to sit upon a new board, during a new term, to levy a new rate, and to spend a good deal of the new revenues in paying new officers and erecting new buildings. Thus there has been created, not a system but a chaos; a chaos of areas, a chaos of elections, a chaos of authorities, a chaos of rates, a chaos of returns." ("Local Administration," page 14.)

Jungle of Institutions.

This jungle of institutions is, of course, firmly rooted in the soil by vested interests of all kinds. Every petty board or authority must have its own staff for the purposes of its work, however unnecessarily large or expensive that staff may be.† Confusion, extravagance, waste of time power and money, are the necessary outcomes of such a system.

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in the United Kingdom." Cassell & Co., 1882. [More as to the history of the question].

2. "Local Government," by M. D. Chalmers, M.A. One of the English Citizen Series. Macmillan & Co., 1882. [More as to what it is].

3. "An Outline of Local Government and Local Taxation in England and Wales," by R. S. Wright and H. Hobhouse. W. Maxwell & Son, 8, Bell Yard, 1884. [More as to the law on the subject].

4. "Local Government and Taxation," by Wm. Rathbone, M.P., Albert Pell, M.P., and F. C. Montague, M.A. One of the "Imperial Parliament" Series. Swan, Sonnenschein & Co., 1885. [A popular exposition of the whole question].

* "Considerations on Representative Government." By John Stuart Mill, chapter xv. London: Parker, Son & Bourn, 1861.

† The Census of 1881 gives the number of officials employed in the business of Local Government as 53,493; and the amount paid in salaries by local

Local administration must be simplified.

We may start, therefore, with the truism that local administration must be simplified. This chaos of areas, and chaos of everything else, of which we hear so much, must be turned into cosmos. We must have a single area for all local business, administered by one authority, elected on an uniform basis, and exercising identical powers all over the country. Our local burdens must be fairly apportioned; our rates must be unified; and the state of our municipal finances must be consolidated and kept under control.*

Reasons for present indifference of citizens as to their Local Government.

It is of no practical moment to us at this juncture to speculate upon, or to analyse too closely, the reasons for the indifference which has heretofore been manifested by the people at large as to the way in which they are locally governed. Mr. Rathbone, M.P., an acknowledged master of this difficult and complicated subject, thinks that our system of local government has by its own exceeding complexity, been guarded from criticism and condemnation.

"So gradual in its development that its history could not be fully given without also giving the whole political and social history of our country; so often amended that the Acts of Parliament relating thereto would compose a very respectable library; so intricate that the local taxation of this realm is raised by no less than three-and-twenty distinct kinds of local authority; yet so rudely constructed that to trace out the relations, the powers, duties, and liabilities of the twenty-three might tax the best-trained legal intellect; so mysterious in its workings that we might safely challenge the most practised man of business to tell even the names of the various local bodies by whom he is taxed and ruled, our Local Government has eluded the general censure, because very few of us could spare time and trouble to find out what it did or where it resided. It has hitherto escaped the fate which must at length overtake every bad government, because it was so bad as scarcely to be a government at all. Yet an intelligent and vigorous local administration is of immeasurable consequence to a free, busy, and highly-civilised country like our own."†

We devote an enormous amount of our national strength to the task of legislating, and we scrutinise with rigour the growth of the national estimates. But we allow our local expenditure

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authorities was calculated by Major Craigie in 1877 at fully £2,400,000 per annum (Journal of the Statistical Society, vol. xl., p. 282.)

* It is beyond my present purpose to compare the Local Government of England with that of Foreign countries, but a vast amount of valuable information as to foreign systems is contained in the Cobden Club Essays on Local Government, published in 1875 (Cassell & Co.). A more popular account will be found in a paper by Sir Charles Dilke, in vol. xxxvii. of the Statistical Society's Journal, pages 313–321.

† "Nineteenth Century," February, 1883.

to increase without question or inquiry, for the very sufficient reason, perhaps, that none of us can see and grasp it, nor control it if we could. Legislation need not of necessity go on, but administration must. Inasmuch as our national health, our national relief of the distressed, our national education, our national internal safety, are in the hands of our local governing authorities, the method in which the administration of such authorities is effected, and its cost, should be matters of very considerable and active interest to us all. Except, perhaps, in large and flourishing boroughs like this, it is a mere truism to say that they are not; that the average citizen, bewildered by the multiple organisations which claim a right to rule over him, and to exact toll from him, gives up the task of unravelling the tangled skein of local government as a hopelessly bad job, and allows local administration to be captured by people who make vestries and local boards the medium of what is expressively termed on the other side of the Atlantic "log-rolling." And as to control of the local finances, the ordinary ratepayer, as Judge Chalmers well observes, "looks on a rise in his rates in the same way that he looks at an increase in his rainfall. Both are matters to be grumbled at, but in neither case does he inquire into causes, and he considers the one as irremediable as the other."

Local Administration affects and should therefore interest everybody.

This ought not to be. We ought to strive to attract the best intellects to the service of the community, and to make the office of local councillor a distinction, instead of, as it is in many parts of the country, something of a reproach. We can only do this by making the local council important enough to attract to it men of the stamp we desire to see upon the board. There is but small encouragement for a man of parts to sit upon a school board, or highway board, or sanitary board, to fritter his time away in the discussion of petty details in which he takes little or no interest. Whereas, if all the business of a locality were concentrated in one board, it would be a worthy object of citizen ambition to have a seat at it; and there would be a sufficient variety of duties to find for each member congenial work on one or other of the committees to which the detail business of necessity would have to be confided. In these boards, too, men would be trained for the larger business of imperial government, and would come to recognise, what so few of our "machine" politicians can be brought to understand, that the other side may have some arguments that are worth listening to, and some ideas that are worth adoption.

The best intellects should be attracted to the local service of the community.

Training for imperial duties.

Centripetal influence of the Metropolis.

It is a little fanciful perhaps, but there is one other aspect of the reform and dignifying of local self-government which I think wants attention. No one can fail to have been impressed with the extraordinary centripetal influence which the Metropolis has exerted over the dwellers in the provinces, since the introduction of railways and improved methods of communication. The huge and overgrown province of houses that we call London attracts to itself more and more people year by year, and tends to suck the life-blood of the intellectual culture of provincial communities. There are many reasons for this. One certainly is that as London arrogates to itself more and more the dictation of everyone's life and modes of thought, provincial interests have ceased to absorb those who fifty years ago were content to have a share in county business, or to do their duty as citizens in some honourable but obscure local office.

Reformed Local Government as a centrifugal influence.

Now I should like to see the business of local government exercising an influence that should act centrifugally as regards London, and restore to our local councils that enlightenment and interest which they lack at present. A statistician recently told us that in another 36 years or so, the Metropolis and its outer ring of districts will, at the present rate of progress, contain more than seven millions of people* ! One is almost inclined to cry out for the re-enactment of the old statute of Queen Elizabeth forbidding the further growth of London. The struggle for existence grows daily more and more keen; the fight for notoriety and eminence more and more intense and painful. Would this latter not be allayed to some extent if it came to be generally recognised that there was dignity and profit, in the right sense of the word, attaching to the performance of duties in local Parliaments as well as in the National Council? People who in London are nobodies might in the provinces achieve a quite considerable and enviable reputation. If the present centripetal tendency could be turned into a centrifugal one, the happiest results would arise for everybody.

AREAS.

In proceeding to discuss the various directions which reform should take, the initial difficulty, and I am prepared to admit that it is the most formidable one, is that of areas. Mr.

* Mr. R. Price Williams, C.E., Paper to the Statistical Society, June, 1885.

Goschen's oft-repeated and now somewhat thread-bare remark about "the chaos of areas" but feebly expresses the utter hopelessness of affairs at present. A dweller in a town lives in four kinds of districts, none of which are conterminous (unless by accident) with any one of the others. He is governed by six kinds of authorities, and these authorities and their districts are mostly different for inhabitants of different parts of the same town. He has to pay at least four kinds of rates, which are not all assessed on the same principle; and he is subjected to the burden of a number of debts charged on the different areas which happen to include his house. There are a variety of minor matters in which the district authorities and rates are additionally multiplied and complicated, concerning which I cannot now go into details.

Chaos of areas.

A mere enumeration of some of the areas may suffice to show the complication at present existing. We have the parish, the hundred, and the county, the two latter being multiples of the first; the union, which is an area by itself; the urban sanitary district or borough, which also corresponds with nothing, and may intersect any number of parishes, and even more than one county; the highway district, and the School Board district: to say nothing of the coroners' districts, the petty sessional districts, and the electoral districts.

Different kinds of areas.

There is a universal opinion amongst those who have had occasion to examine the question of areas in its practical working that the present system is utterly irrational, confusing, and absurd. I could adduce any number of authorities to prove this contention, but it is hardly necessary. I shall content myself with quoting what two Government organisations have to say on the subject.

General agreement as to confusing and absurd complication of areas.

The Royal Sanitary Commissioners, in their Second Report of 1871, proposed (p. 53) that sanitary government should be committed to one authority in every area, and laid "the utmost stress upon the importance of taking every possible step towards introducing coincidence" of area.

"Unions, and sometimes even parishes, overlapping county boundaries; registration districts making incomplete correspondence with them in statistics of births and deaths; highway districts made optionally, and irrespectively of all other areas, or coinciding sometimes with one, sometimes with another; petty sessional divisions generally differing from all: cause altogether to a country whose life is self-administration, probably the maximum of embarrassment and waste of local government, and the utmost loss of means and effectiveness."

The Census Commissioners of 1881 complain bitterly both in their first and fourth reports of the trouble caused to them and to their enumerators by the present chaos of boundaries. They observe:—

"England and Wales have been parcelled out at various times in a multiplicity of ways for diverse purposes; and it has often happened that, when a new parcelling out for some special purpose has been in hand, those entrusted with it have laid out their new areas without any, or with insufficient, regard to pre-existing areas of administration. The boundaries of civil and of ecclesiastical parishes, of municipal and of parliamentary boroughs, of urban and rural sanitary districts, of registration counties and counties in the ordinary sense, not to mention numerous other sub-divisions of the country, overlap and intersect each other with such complexity, that the enumerators and the local registrars in a vast number of cases failed altogether to unravel their intricacy. Nor is this to be wondered at, seeing that often no official or authoritative statement of the exact boundary of an area was procurable."

Examples of intersection of areas.

The census of 1881 shows that fourteen boroughs (Abingdon, Bristol, Burton-on-Trent, Cardigan, Oxford, Peterborough, Stalybridge, Stamford, Stockport, Sudbury, Tamworth, Thetford, Warrington, Yarmouth), and 22 local board or improvement commissioners' districts, are in more counties than one. The number of urban sanitary districts that intersect parishes is too large to be counted without much trouble and exploration.

The urban sanitary district of Mossley comprises parts of four registration sub-districts, parts of four parishes, parts of two unions, and parts of three counties, but only parts of two registration counties. The municipal city of York, which together with the Ainsty is included for parliamentary purposes in the North Riding, is included for registration purposes in the East Riding, and for all other purposes in the West Riding. The parliamentary borough of Stoke-upon-Trent consists of parts of six civil parishes and parts of four unions, and contains four municipal boroughs. Halifax registration district contains one rural sanitary district and 19 entire urban sanitary districts, with part of one other. The boundaries of 13 of these 19 districts do not correspond to any parish boundaries. Bury registration district includes one rural sanitary district, and four entire urban sanitary districts, with parts of three others. There are in this registration district 12 civil parishes or townships, and of these only two are not divided for registration purposes, the other ten being split up so as to have portions in two, three, or more registration sub-districts. Moreover, each of six of the parishes contributes parts to two or more sanitary districts. The parish of Ashton-under-Lyne, at

the date of the census, contributed parts to no fewer than six urban sanitary districts, and to one rural sanitary district. It also comprised three registration sub-districts, and part of a fourth. The registration district of Crickhowel contains one rural sanitary district, one entire urban sanitary district, and parts of three others. The remaining part of each of these three is not only in a different registration district, but in a different county.

Who can wonder at the despair with which these anomalies and intricacies have filled the hearts of our reformers?

THE NEW UNIT OF LOCAL GOVERNMENT.

Unit of area to be the same for all local purposes.

Simplification of area and authority is therefore a cardinal necessity. The unit of area should be the same for all local purposes, and larger areas should be as far as possible exact multiples or aggregates of that unit.* This is generally agreed; but as to the proper unit to be taken, opinions differ widely. The parish has been favoured by the earlier reformers, and was indeed proposed by Mr. Goschen in his Rating and Local Government Bill of 1871 as the primary unit of local administration in rural places. But then, to use his own words, he "proposed to reconstitute the parish entirely." † Throughout his speech he spoke more or less disparagingly of the parish, and apparently only adopted it because it was less objectionable than the poor law union. For organisation this Bill provided a parochial board with nothing very definite to do, except that the chairman was to be civil head of the parish, and vote in the election of a county financial board. It left, without attempting a remedy, the confusion of powers, authorities and areas; and it added another authority.

The Parish as the Unit.

Arguments for the Parish.

The milder kind of reformers urge in favour of the parish as the primary unit, that it has a history; that it carries us back a thousand years into the past; that a certain sentiment attaches to it which its rejection as the unit of government would destroy, and last, and most practically important, that it comparatively seldom overlaps the county boundary, and has already been used as the foundation of areas and petty sessional divisions.

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* Second Report of Royal Sanitary Commission, vol. I. (C. 281, 1871), p. 54.

† Speech of 3rd April, 1871, on moving for leave to bring in the "Rating and Local Government Bill." For a full report of this speech see pages 189 *et seq.*, of "Reports and Speeches on Local Taxation," by G. J. Goschen, M.P. Macmillan & Co., 1872.

Arguments against the Parish.

Now it is undoubtedly the fact that we can trace the descent of the modern civil parish, through the ecclesiastical parish, up to the old Saxon township.* Some indeed have carried its lineage still higher. But as an administrative unit, the parish is now of no importance whatever. Its varying size and primitive organisation render it unfit for efficient administration; and one by one its governing functions have been taken from it and transferred to others. Its only administrative use at the present day is as the unit for taxation and electoral purposes; all rates included in the poor rate being collected parochially, and the list of voters for Parliamentary and Municipal Elections being also made out parochially. Moreover, parishes are of all sizes and all populations. Their importance, as parishes, dates from the poor law of Queen Elizabeth, and still more from the Settlement Act of Charles II.; and they are further entangled in the question of ecclesiastical organisation, which introduces further difficulty. An enormous number would for one reason or another have either to be grouped together or subdivided, and in that case where is the local sentiment to come in?

There are many parishes with an area of less than 50 acres, and many with an area exceeding 10,000 acres. There are 800 parishes with a population of less than 50 persons, and 6,000 parishes with a population under 300. On the other hand, there is a considerable number of parishes with a population exceeding 30,000. Toxteth Park township contained 109,455 people at the last census. The average population is about 1,500, and the greater number of parishes have a population varying between 200 and 1,000. In 1873 there were more than 1,300 parishes which were not contained in a ring fence boundary, positions of parishes being intermixed with the lands of other parishes. This number has since been reduced under the operation of the Divided Parishes Acts of 1876-9 and 1882, but not very materially.

Again, Urban Sanitary Districts have been, in a multitude of instances, carved out of parishes without any respect for parochial boundaries. What is to be the status of a parish which has part of its area inside a borough and part outside? Another fatal objection is that for most administrative purposes a parish is too small. It would be impossible to get a sufficient number of persons willing and qualified to attend properly to local government if every parish had its separate governing body.

* For a very instructive summary of the early history of our local institutions, see Vol. I., of the present Bishop of Chester's learned "Constitutional History of England." (Oxford, 1874).

Appreciating these difficulties, other reformers have fastened upon the Union as the future primary unit. But here again, any quantity of rectification would be needful before we could get uniformity of area. It is generally felt that any re-casting of our counties is out of the question. The feeling of local sentiment in the case of counties is very strong, and the friendly rivalry between different parts of the kingdom is very important to be kept up. If we were dealing with an absolutely new country with no history, we should no doubt portion it out differently, but we have to deal with an area honourably known to history for a thousand years at least. We have happily not the same reason for abolishing our counties that the French had for converting their provinces into departments at the time of the Revolution: and county boundaries will have therefore in any revision of local government to be respected.

The Union as the Unit.

Counties must be retained.

My reason for this apparent digression will be seen immediately. Unions were created in 1834 by a staff of central inspectors whose instructions were to make the best grouping of parishes that could be devised, but at all events to get the principle of poor law union accepted in some form or other. As I am not sure that people at large understand the way in which these unions were carved out, believing that there must have been some geographical or topographical principle underlying their formation, I think it well, in order to dispel any illusions on the subject, to disinter from the evidence given before the Royal Sanitary Commission the plain statement of Sir John Lambert, the late Secretary of the Local Government Board, than whom no one was more familiar with the facts. According to Sir John's evidence*, at the period when the country was divided into Unions, the Poor Law Commissioners sent assistant commissioners down into all parts of the country to make inquiry as to the most convenient way of arranging groups of parishes into unions having regard to the area: that it should not be so extensive as to create inconvenience in the administration of relief, and that the population of the parishes to be united should be sufficiently extensive to warrant the formation of a union. (Q. 4671). As a result of that grouping, there was a great difference in the population of unions, arising in many instances from the fact that some districts were very extensive and had a very small population in them, whilst where a population was found entirely homogenous and formed one community, it would be embraced in one and the same union. (Q. 4672.) But in the formation

How Unions were created.

* First Report of the Royal Sanitary Commission, page 259.

of a union there were other things that had to be taken into account, such as the existence of local Acts and the difficulty of obtaining the consent of certain persons where those local Acts were in force; so that it was found not only expedient but necessary in a number of instances to depart from some of the general principles that had been laid down. (Q. 4673.) The assistant commissioners placed themselves in communication with the principal residents, landowners and magistrates in the district, calling a meeting and proposing their plan, hearing what objections there were to be made to it, and what suggestions offered for its improvement. They then made their report to the Poor Law Commissioners, who under the act of 1834 had absolute power to unite as many parishes as they thought proper into a union, except in those cases where parishes were under local Acts, when they had no such power. (Q. 6474.) But when they recommended combination into unions, where that combination was carried out, regard was had to local feeling irrespective of the localities. (Q. 6475).

It would be difficult to find any process of area-making more elastic or squeezable than this. And what is the result? At least 176 out of the 617 extra metropolitan unions, or considerably more than a fourth, cut into the boundaries of counties, often in the most complicated way. Twenty-nine unions are in three counties each, and four in four counties each; only eight of the 617 unions are co-extensive with municipal boroughs. Only two counties (Northumberland and Cumberland) have their boundaries co-incident with those of unions. The unions vary in size from West Derby (Lancashire), with a population of 360,000, down to Sedbergh (Yorkshire) with 4,000, and Hoo (Kent) with 3,100 inhabitants.

Intersection by Unions of county boundaries.

These unions are moreover whole and undivided only for poor-law purposes. For sanitary purposes their area is diminished by nearly 1,000 boroughs and urban sanitary districts, which intersect unions as well as parishes in the most perplexing manner, are of all sizes and populations, and have had their boundaries settled on no regular and systematic plan.*

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* Mr. Hagger's description of Liverpool at the Poor Law Conference of 1877 has often been quoted, but it so powerfully supports my argument that I may be pardoned for re-producing part of it here:—

"When the country was divided into unions, the parish of Liverpool, which was then conterminous with the municipal borough of Liverpool, was formed into a separate poor law district as a single parish, and twenty-three of the surrounding townships were formed into the West Derby Union. Subsequently the municipal borough was extended, so as to include two of the adjacent townships and portions of two others. Then the township of Toxteth Park was separated from the West Derby Union, and formed into a distinct poor-

Arguments against the Union as a Unit.

To adopt the Union as the primary unit would therefore involve first of all the rectification of the areas of at least a quarter of the Unions, and a decision as to the merging of a large proportion of the smaller urban districts. This task could only be usefully attempted if there were a reasonable chance of unions becoming effective administrative areas: and in my view, the adjustments would have to be so numerous that nothing but the husk would remain of the working capacity, which is after all the great argument in favour of the unions as areas. Moreover, the grouping which might have been convenient fifty years ago has become inconvenient or not so convenient as others, through changes of population, and the development of railways and other means of communication, so that unions are not entitled to any special consideration on the head of convenience.

It is no doubt true that boards of guardians are the only bodies which at present have the elements of local organisation strongly developed; but they are not bodies that are much looked up to, and the same or a stronger common life would rapidly centre round any other district more convenient than the union upon which the same or wider powers were conferred.

Consideration of other existing areas as Units.

The petty sessional district and the highway district may be dismissed at once. They are of all sizes and shapes, and have nothing to recommend them from the sentimental point of view. Hundreds, on the other hand, have a very old and honoured history; but they are now so split up into fragments that their revival as a unit for reformed government would be out of the question. The only remaining area which is possible is that suggested by Mr. B. F. Lock, in his paper read before the Social Science Congress in 1880 *: a paper admirably clear and well-reasoned. Mr. Lock argues at some length in favour of the electoral divisions under the Ballot Act, which have been specially planned since 1872 for the purpose of convenience of access and facility of locomotion, all being grouped round a town or large village.

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law area, under a separate board of guardians. There have been also formed within the same area eleven local board districts and a second municipal borough, that of Bootle. Thus, there are within this area—which is practically that of the West Derby Union—two municipal councils, three boards of guardians, eleven local boards of health, twenty-four bodies of overseers; and there are besides five burial boards, two school boards, and one highway board, making a total of forty-eight local authorities acting in complete independence of each other; the complication being increased by the fact that a single board exercises its different functions over different areas. Thus, the West Derby Board of Guardians have control over the whole twenty-two townships in the union for poor law purposes, whilst they are the rural sanitary authority in only ten of them, and the educational authority in eighteen and a half."

* Transactions of the Social Science Association for 1880, pages 697 *et seq.*

Speaking generally, I find much to approve in Mr. Lock's scheme; but I do not think we have at present the materials for assessing the workability of these respective suggestions.

Boundary Commission should be appointed.

It appears to me that a first step in the reform which we hope to attain is the institution of a Boundary Commission, with instructions to examine in detail and geographically the various areas now in force in each county, and to see how far they can be harmonised and unified on one comprehensive plan. The really wonderful way in which the recent Boundary Commission got through their very laborious and delicate work, and the surprisingly universal acquiescence in their decisions throughout the country, seems to me to be of the very happiest augury for the success of a similar Commission for settling the areas of local government. Some words, in fact, of Sir Charles Dilke would seem to imply that there was, at one time at any rate, an idea of extending the functions of Sir John Lambert's Commission with this view. The Commission is still being kept alive, possibly with some object of future usefulness, and I can imagine nothing more fitted to expedite the reform of local government than the inauguration of a Boundary inquiry such as I have suggested.

In settling areas regard must be had to characteristics of locality.

In settling the areas for local government, regard should be had not only to the symmetry of the area, but to the natural characteristics and boundaries of the locality and the class of inhabitants that dwell in it. Dr. Rumsey gives, in one of his works,* a striking instance of contrariety in the selection of areas for registration purposes :—

"The Forest of Dean is an extensive district, of remarkable geological formation, bounded on two of its three sides by important rivers, and inhabited by a distinct class of people, living for centuries past under peculiar laws and local customs, and now largely employed in mining and metallic works. One might expect that the published statistics of mortality and reproduction in the Dean Forest would throw some light on the physical and sanitary condition of its inhabitants. But the census and registration returns give no precise information on the subject, and not only do those districts (unions) which contain most of the Forest parishes, include other parishes, outlying and different in kind, but no fewer than twelve of the real Forest parishes, with a total population of more than 20,000, are included in unions belonging to the adjacent 'Registration counties' of Hereford and Monmouth. Nor do the Forest portions of these unions constitute separate sub-districts, so as to admit of being again grouped together for statistical returns. To determine, therefore, the longevity, mortality, and sanitary

* Essays and Papers on Some Fallacies of Statistics. By Henry W. Rumsey, M.D., F.R.S. Smith, Elder, and Co. 1875. (Page 3).

state of this singular people would require a new territorial distribution of the population, and a new compilation of primary facts."

Another and very obvious point would be that the district must be important enough to treat the problems of government in a scientific spirit, and at the same time compact enough and manageable enough to ensure the practical and business-like supervision of details.

PRIMARY AUTHORITIES.

Present authorities for Local Government.

For each of the existing areas there is of course an authority fulfilling functions more or less important. But I doubt if many people know or appreciate the astounding number of separate organisations that now exist for one or another purpose of local government. A recent Parliamentary return (No. 96 of 1885) gives some figures on this head which may be worth reproducing. For 1882-3, accounts were received from the following number of local authorities in England and Wales :—

Poor Law Boards of Guardians	647	Bridge and Ferry Trustees	29
Overseers of Poor Law Parishes	14894	Metropolitan Sanitary Authorities, &c.	45
County Authorities	63	Commissioners of Sewers (Extra Metropolitan)	54
Municipal Corporations	247	Drainage, Embankment, and Conservancy Boards	178
Urban Sanitary Authorities	970	Churchwardens (Church Rate Accounts)	182
Rural Sanitary Authorities	577	Harbour, Pier, and Dock Authorities	62
Port Sanitary Authorities	47	School Boards	2115
Joint Boards	21	Highway Authorities (Rural Sanitary Districts)	6890
Burial Boards	882	Turnpike Trustees	113
Commissioners of Baths and Washhouses	12		
Lighting and Watching Inspectors	187		
Markets and Fairs Commissioners	7		

Or a total of 28,222 authorities in all, levying at least 18 different kinds of rates.

Distribution of duties amongst these local authorities.

The *relief of the poor* is looked after exclusively by boards of guardians, who also control, as such, public vaccination, the registration of births, deaths and marriages, assessment for poor rates, attendance at elementary schools where there is no school board, and the charges of pauper lunatics. Most of the work that we are accustomed to class as "*sanitary*" is performed by town councils, local boards, or other urban authorities; or in default of such, by boards of guardians acting as "rural sanitary authorities." The powers of rural are not so great as urban authorities. Both are responsible for water supply, sewerage and drainage, the inspection and prevention of nuisances, and the limitation of the spread of infectious diseases. But an

urban authority has in addition powers as to town improvements, lighting, maintenance and regulation of streets and roads, new houses and the like, which are not possessed by rural authorities.*

The *highways* are now under a variety of jurisdictions. There are (*a*) the highway "parish," (*b*) the highway district, and (*c*) the district of an urban or rural sanitary authority exercising highway powers. About 6,000 parishes now separately maintain their own highways. There are about 362 highway districts, composed of some 8,000 rural parishes combined for highway purposes. Every urban sanitary authority is, by virtue of the Public Health Act, the exclusive highway authority within its district; but rural authorities do not, as a rule, exercise any highway powers, though they may be invested with such powers under the Highways and Locomotives Act of 1878.

The maintenance of *elementary schools* may be either under the care of school boards elected *ad hoc*, the area for which boards is always a borough or poor law parish. When a school board is not desired, primary education is placed under the supervision of a school attendance committee. In boroughs this committee is appointed by the town council, in urban sanitary districts by the local authority, and in rural districts by the boards of guardians.

It might have been thought that the guardians of the public health would have been the fittest authority for securing the proper and decent *burial of the dead.* But even here our passion for multiplying authorities manifests itself. The boards to whom we commit this lugubrious function consist of a committee of ratepayers nominated by the vestry; though the board once appointed has power to fill up its own vacancies, and thus can arrogate independent functions. The Burial Acts may also be adopted by any poor-law parish, or by any ecclesiastical parish, or by any township or district, although embraced in a common-law parish which has already a burial board of its own. And when any portion of a common-law parish has acquired a separate burial board, the remnant of that parish is entitled to have a similar board.

The duties of the other local authorities mentioned in the above list scarcely call for detailed description.

Unification of Authorities.

It has been argued against the proposed unification of local authorities, that the duties now performed locally are so diverse that they could not all be fulfilled by the same body. As

* This senseless and utterly unnecessary distinction should at once be swept away; indeed, with a revised local authority there would be no place for it.

well might one say that because the objects of Imperial Government are many and varied, therefore we should have a separate ministry to look after the Army, another for the Navy, another for the administration of justice, and so on. We have only to imagine each department of state "working by itself, drawing up a detached budget of its own, for its own independent parliament, and obtaining for itself the grant of a separate income-tax," which would be the strict Imperial analogue of our present local system, to reduce this argument to an absurdity. No doubt in the future the affairs of the unified local authority would fall more and more under the immediate supervision of committees acting in its name, though responsible to it; but this is only applying to local administration principles of division of labour, which hold good and work well in every other department of industry.

Arguments against unification.

It is contended, too, that this unification of area, this suppression of the myriad petty authorities that now divide amongst themselves the duties of local government, would render useless all the machinery that has been forged at so great a cost, and destroy many old and valuable historical associations. Not at all. No machinery that was worth preserving would be thrown aside. We should only fit new motors to it in place of those that were old, worn out, and unfitted to present circumstances. As to historical associations, what halo of sanctity clings round the poor-law union that we should gaze at it with bated breath, and hesitate to invade its sacred area? It is a creation of fifty years old, which until twenty years ago had no common life growing up around it. The parish is unfitted, from its diversity of size and population, to become the unit of local government, and, moreover, the course of all recent legislation has been to deprive it of such powers as it formerly had. Highway areas are largely co-extensive with parishes. Local boards are barely twenty years old; rural sanitary boards only thirteen years old; school boards fifteen years old. Why should we be thought to lay sacrilegious hands upon local government in the abstract, because we propose the amalgamation and co-ordination of these manifold, intricate and irrational organisations?

Unification does not mean destruction.

Present authorities are nearly all of modern growth.

Let our reformers take heart at what was done fifty years ago for the reform of municipal corporations. The circumstances of 1835 and 1885 are in many respects strikingly similar. At both periods there has been a reforming spirit in the air. Having put the Imperial Government in order in 1832 by the

Precedent of reform of Municipal Corporations in 1835.

passing of the great Reform Act, our legislators set to work to attack municipal government, or rather misgovernment, which then existed in rank luxuriance.*

Shall I affront your Leicestral susceptibilities by reminding you that during the election of 1826, the then unreformed corporation of Leicester spent £10,000, and mortgaged part of their property to secure the return of a political partisan? †

The Municipal Corporations Act of 1835, whose jubilee was celebrated on the 9th instant, swept away all the manifold abuses that then disfigured municipal government, and provided, instead of an infinite variety of rotten and antiquated charters, an uniform constitution for all boroughs to which it applied, based on the model of the best administered municipal corporations existing at that time.

We have just undergone, though with an entire absence of the excitement and rioting of fifty years ago, an equally profound change in the character of the Parliamentary electorate. The marvellously quiet manner in which that change has been brought about, and its now universal acceptance by all parties, lead one to hope for a similar greeting to and acquiescence in any well-devised system of reform which shall bring unity, efficiency, economy, and a better reflection of the popular views into the counsels of local governing bodies.

On this subject of unification of area and functions, Mr. Mill's remarks are peculiarly *apropos*. He says:

Mr. J. S. Mill on the Unification of Local Government.

"In each local circumscription there should be but one elective body for all local business, not different bodies for different parts of it. Division of labour does not mean cutting up every business into minute fractions: it means the union of such operations as are fit to be performed by the same persons, and the separation of such as are better performed by different persons. The executive duties of the locality do indeed require to be divided into departments for the same reason as those of the state; because they are of diverse kinds, each requiring knowledge peculiar to itself, and needing, for its due performance, the undivided attention of a specially qualified functionary. But the reasons for subdivision which apply to the execution do not apply to the control. The business of the elective body is not to do the work, but to see that it is properly done, and that nothing necessary is left undone. This function can be fulfilled for all departments by the same superintending body; and by a collective and comprehensive far better than by a minute and microscopic view. It is as absurd in public affairs as it would be in private that every workman should be looked after by a superintendent to himself. The government of the Crown consists of many departments, and there are many Ministers to conduct them, but

* For details of some of the scandals then rife in the administration of Municipal Corporations, see *Sanitary Record* for September, 1885.

† Report of the Commissioners on Municipal Corporations, 1835, page 54.

those Ministers have not a Parliament apiece to keep them to their duty. The local, like the national Parliament, has for its proper business to consider the interest of the locality as a whole composed of parts, all of which must be adapted to one another, and attended to in the order and ratio of their importance." *

Position of Large Boroughs in Scheme of Local Government.

An obvious criticism on the proposed amalgamation of all duties of local government in the hands of one authority would be the impossibility of carrying it out whilst populous boroughs were maintained as separate organisations. Certainly no one would wish to destroy corporate activity in large cities, and I am prepared to admit that the performance of all local functions in a town like this (Leicester), for example, by one single board, would be a serious, perhaps too great, a strain upon its members. For a great corporation to be under the control of the County Board (to be presently spoken of) of hardly, if at all, superior rank to itself, would be justly felt a grievance, and would deter good men from coming on the council. Seen at close quarters, however, these difficulties disappear. All that is necessary is to make each large town of say more than 100,000 inhabitants a "county" by itself, as is already the case in 19 towns† of very various populations for a different reason. And, after all, there would not be more than 30 places at the outside that would require this exceptional treatment. The Registrar General gives us weekly returns as to London and the 27 largest towns in England and Wales. These and their estimated populations in the middle of 1885 are as follows:—

Position of large towns as Units of Local Government.

To be made counties corporate.

Town.	Population.	Town.	Population.
Birkenhead	93,093	Liverpool	579,724
Birmingham	427,769	Manchester	337,342
Blackburn	112,574	Newcastle-on-Tyne	153,209
Bolton	110,085	Norwich	91,215
Bradford	214,431	Nottingham	211,424
Brighton	114,672	Oldham	126,390
Bristol	218,169	Plymouth	76,045
Cardiff	97,034	Portsmouth	134,659
Derby	89,691	Preston	100,406
Halifax	77,378	Salford	204,075
Huddersfield	87,327	Sheffield	305,716
Hull	186,292	Sunderland	125,327
Leeds	333,139	Wolverhampton	79,185
Leicester	136,147		

* "Considerations on Representative Government." By John Stuart Mill, pp. 273-4. London: Parker, Son and Bourn, 1861.

† It may be useful to give the names of these 19 cities and boroughs which

In these towns, then, the major authority should possess all the attributes of a County Board as subsequently defined. Whether the detailed work of the local administration as to health, medical relief of the poor, education, highways and the like could be better accomplished in such towns by a wholesale delegation of powers and duties to committees, or whether it would be preferable to appoint sub-authorities for wards, corresponding in their functions with the "primary authorities" in less populous places, may be left for future consideration.

Detailed work of Local Administration in large towns.

Perhaps it might be possible in counties where there were a good many considerable towns below the 100,000 population provisionally fixed upon as the limit for a County Authority, to clothe them either alone or in combination (though in the latter case local jealousies would be sure to arise) with similar County powers. The boroughs still smaller, which would no doubt be the most tenacious of their franchises, need not be absolutely destroyed. No sentiment has yet gathered round a local board district or a poor law union. But a borough links us in a way with the past, and I have not the least desire to do away with what a little girl once identified with the "pomps and vanities of this wicked world"—the Mayor and Corporation going to Church in full regalia. The boundaries and boroughs would of course have to be altered where necessary so as to fit in with the new primary areas to be settled by the Boundary Commission; but otherwise their organisation might be retained, added splendour being given to their deliberations by the accession of new and important duties.

Position of smaller Boroughs.

For the "primary areas" in the new dispensation which will not be boroughs, the excellent name of baronies has been suggested by Mr. Benjamin Fossett Lock.* "Barony" is the Norman successor of the old Saxon "hundred" (which name cannot be used as it would conflict with the actual hundreds that still exist for some purposes), and it is a name common to England, Scotland and Ireland. Indeed in the latter country it is of some considerable importance; and its adoption for our new "primary area" may I think be unhesitatingly approved.

"Baronies."

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are separate counties (sometimes called *counties corporate* as contrasted with *counties at large*), though the dignity is of no particular legal importance at present, except that they elect their own sheriffs.

Counties of Cities.—Bristol, Canterbury, Chester, Exeter, Gloucester, Lichfield, Lincoln, London, Newcastle, Norwich, Worcester, York.

Counties of Towns.—Berwick, Carmarthen, Haverfordwest, Hull, Nottingham, Poole, Southampton.

See p. 71 of "Justice and Police," by F. W. Maitland. (Macmillan & Co., 1885).

* Social Science Transactions, 1880, page 701.

Constitution of Primary Authorities.

Having settled our area of local government, the next point should be the constitution of the administrative body and the mode of its election. As to this there is not much to be said. It has already been argued that for all local business there should be one authority, and one only. Municipal corporations, local boards, highway boards, boards of poor law guardians, school boards, burial boards, and the other boards that now vex the soul of the ratepayer would disappear as such, their functions being all performed by committees of the unified local authority. So that we should at once sweep away all those extraordinary variations in the qualifications of local councillors and in the mode of their election, which the ingenuity of the draftsmen of different Acts has devised. It would be impossible to explain these permutations in a connected statement, and I would therefore refer enquirers to a very useful table which was prepared in the office of the Local Government Board for the use of a Select Committee of the House of Commons of 1878, on the election of Poor Law Guardians. Town councils are elected on the 1st November, local boards in the first week of April, highway boards on the 25th March, and school boards at any time of the year. School boards once elected endure for three years; Highway boards and boards of guardians only for one year; whilst in town councils and local boards one-third of the members retire every year. The rating which gives a man only one vote for a town councillor, may give him six when he is voting for a burial board, and an intermediate number when he is voting for a board of guardians. Sometimes a ratepayer can vote by filling up a paper, whilst at others he must attend at a polling station; sometimes he gets placed on the voting list without any personal trouble, at others he cannot vote because he has not made a formal claim; sometimes the voting is conducted openly without concealment, whilst at others it is secret, and a divulging of the way in which a vote has been given may invalidate it and get the voter into trouble. For school boards no qualification is required for candidates; they need only be ratepayers to serve on burial boards and highway boards; but for town councils, guardians, and local boards they must be rated in amounts which are different in each case. There is no sort of justification for all this variation and confusion.

Variations in dates and periods of Election.

Variations in voting.

Variations in qualification.

"The system is extravagant in time, in men, and in money. A further and more serious evil, consequent on the dispersion of functions, is this: the

number of capable men able and willing to take part in local government is limited. The numerous boards therefore have to be filled up with very indifferent material. A locality which might well furnish a single board of competent men, is quite unequal to provide four or five such boards. Besides the very limited sphere of usefulness which is open to a man who serves in any one of the existing petty boards, effectually deters many good men from coming forward."*

Uniform system wanted of voting, election, qualification, and tenure.

What we want is one uniform system of voting, election, qualification and tenure of office. This would be provided for by our unified authority. Each ratepayer should have a vote, but only one, and those qualified to vote should be qualified to be elected. This would put working men in a position to get their special wants met, and their special difficulties recognised and provided for. The representation of owners opens up large questions of the incidence of local taxation, into which it is beyond my present purpose to go. But whatever financial reforms may take place with regard to local burdens, it seems inevitable that the owner as well as the occupier will have to take his share of direct local taxation, and in this case he would be clearly entitled, as it would certainly be to his interest, to have a voice in the election of local representatives.

Duties of the Primary Authority.

Conservation of the public health.

On this subject it is not needful to go much into detail; it must suffice to say that to the new local authority should be transferred all local functions which primarily affect the particular district alone. The conservation of the public health in its broadest sense, including, for instance, in that term, the giving of medical relief to the poor, the supervision of public vaccination, the registration of births and deaths, and the burial of the dead, the elementary education of the young, the maintenance of the highways, and generally all matters affecting the well-being of its constituency, should all be under the management of this authority. The law should everywhere be uniform. Powers now only given to urban authorities in one case, and to places over 25,000 population in another, should be granted universally. The senseless and mischievous limitation of the powers of so-called rural authorities should be broken down. In most of the clauses in the Public Health and other Acts in which *may* appears, *shall* should be

Law to be uniform.

* Judge Chalmers on "Local Government," page 23.

substituted for it. It would not of course be needful that every power given should be exercised to begin with; but it should be there, and the scandals of unrestricted and unregulated building by jerry-builders in the so-called "rural" outskirts of great towns should be made impossible.

I need hardly say that a considerable experience and study of public medicine has shown me a number of defects in the law which I should like to see remedied. But the imperfection of our present code of legislation is not so much my theme to-night as the imperfection of our present system of administration. I do not therefore propose on the present occasion any detailed criticism on particular points of law, but shall confine myself as far as possible to statements of principle.

Staff of Primary Authorities.

At present every local authority that now exercises lilliputian sway over a portion of our social life has its staff of officials, the collective salaries of whom are out of all proportion to the work done. Such officials receive remunerations which may appear little more than nominal, but which total up to an enormous aggregate. The amount paid in salaries by local authorities has been calculated by a competent authority at something like two and a half millions sterling per annum. A retaining fee of £10 or £20 simply means that a man does local government work with his left hand when he has time to spare from the pre-occupations which constitute his means of livelihood. In our unification of area and authority there would be no need for this huge undisciplined army. Officials should be required to devote their whole time to the duties of their office, and should be paid a salary which would attract intelligent and business-like men to accept such appointments. I am of course now speaking of the non-technical officials, such as clerks, rate collectors, assistant overseers, relieving officers, registrars, school attendance officers, sanitary inspectors, surveyors and the like. These appointments would not endure in their separate and fragmentary form. They would be consolidated and re-cast, and one official would in future exercise the functions of a good many of the present officers—in sparsely populated areas, perhaps all of them.

Army of present Local Government officials.

The only professional officers which of necessity need be attached to the primary authority would be a legal adviser, who would probably, as a rule, act as the clerk or secretary to the authority, and might also exercise the functions of superintendent registrar;

Professional officers of local authority.

and a medical officer, who would look after the sick poor, and act as general medical adviser to the authority on ordinary matters of health. The latter would be in communication with the superintendent medical officer of health, to be presently referred to; would send him notice of all attacks of infectious diseases; and would take of his own motion such immediate action as to outbreaks and as to nuisances as might be necessary to set the ordinary health law in motion. He would also act as factory surgeon under the Factories and Workshops Act of 1878. But he would not himself make any recommendations as to new works or schemes of sewerage or water supply to the local authority. He would express his views to the medical officer of health, and the latter would then make inquiry and report on the subject.

Medical Officer.

THE COUNTY AUTHORITY.

Necessity of an Authority intermediate between Local and Central Authority.

At the time of the earlier agitation for the reform of local government, to which I referred in my opening remarks, there was less unanimity than at present as to the necessity of an authority intermediate between the primary and central authorities. Although a great majority of the witnesses before the Royal Sanitary Commission spoke in favour of such an authority, the Commissioners themselves did not recommend its creation.* Their opinion is now, however, of little more than historical interest, as the arguments against the establishment of an intermediate authority have been disproved by all subsequent experience. Practically the only witness of any weight that spoke against intermediate authorities was Mr. John Simon, who then held the post of Medical Officer of the Privy Council. Even Mr. Simon thought it possible that the county magistrates "might advantageously act for some special health purposes, and also where the administration is to be over a larger area than that of Unions" (Q. 1828). But in the administration of the nuisance law he thought "there ought to be no successive local authorities, that there should be but the one responsible local authority and the central government to look after it."

Evidence before Royal Sanitary Commission.

It is evident from this answer, and from the fuller views as to the laws and administrative agencies contained in his Eleventh

* Second Report, vol. i., p. 54.

Report to the Privy Council (1868), that Mr. Simon, in expressing a view antagonistic to intermediate authorities, was not contemplating that general reform and unification of local government now in question. He thought that as regarded health matters it would be inexpedient that anything should come between the central authority and the local board in bringing what the latter was doing to the notice of the former. "It would intercept communication rather than promote communication, and diminish the force of stimulation rather than give it effect." (Q. 1973). It has, however, to be remembered that in those days it was thought possible to create a central authority that should directly influence, and, so to say, interfere in the every-day business of local authorities. This bureaucratic dream must since have been effectually dispelled. No one disputes that a power in reserve against recalcitrant, idle, or wasteful authorities is of the highest importance, and that a central office for the purpose of harmonising and assisting local action may be of real helpfulness to the country. But anything more than this, any general supervision or interference in the ordinary functions of a local authority by a department of government, has always been resented, and always will be.

Interference by central authority in every-day local business.

At the same time, there are many matters which require joint action or an area larger than the "primary area" for their proper performance. It has been found enormously difficult to get local authorities to voluntarily combine for any joint purpose whatever; and when they are compulsorily combined, it stands to reason that they are not particularly anxious to make the combination a success. There are perpetual bickerings and struggles for supremacy, and the last state of that joint area gets to be worse than the first. Witness the difficulties which have arisen in the combinations for the appointment of a medical officer of health debarred from private practice. One combination after another has fallen through, and the unfortunate health officer cast adrift. The bond which keeps together those that remain is but a rope of sand.

Difficulty of arranging combinations.

Our primary areas need, therefore, a multiple of some kind to which shall be delegated certain larger functions that an ordinary local authority cannot with economy or efficiency carry out by itself. Such stimulation to activity on the part of the primary authority as is ordinarily necessary could be accomplished by the machinery of the authority for the larger area in a way to be presently explained, and as the county authority would consist

Primary areas require a multiple.

largely of delegates of the primary authorities themselves, there would be less restiveness at such control than at that exercised by permanent Government officials sitting at desks in Whitehall, with little or no knowledge of the practical difficulties in any particular case. When I come to discuss the functions of county boards, I think it will be seen that there is a quantity of good and useful work for them to do, and that their establishment would ensure greater economy and efficiency in our local administration. I content myself therefore for the present with a simple statement of the need for the establishment of an authority intermediate to the primary and central authority.

Inasmuch as sanitary matters form so large a part of the duties of local self-government, it would clearly be desirable that in any mapping out of the country for administrative purposes, the configuration of the country most adapted for sanitation should be studied and as far as possible followed. For the reasons already given, it would, I think, be impossible to adopt as our "intermediate area" anything else than the county, which has many generations of useful work to recommend it, and is hallowed by historical associations which we cannot lightly set aside. Short of an absolute re-arrangement of the whole country, which this century at all events is not prepared for, and which appears in any case to be unnecessary, the only alternative to the country as an "intermediate area" is that of the watershed. Now there is much to recommend a watershed as an area for sanitary purposes, and, as Mr. Tom Taylor well observed in his evidence before the Royal Sanitary Commission, a watershed board, if we were absolutely free to choose, would be most naturally fitted to be the intermediate authority.*

Question of watershed areas.

Sir Henry Thring, the Parliamentary Counsel, would establish a conservancy board over a whole river basin; Sir Robert Rawlinson would map out the whole kingdom by its watersheds under River Conservancy Boards, and put each tributary river area under a Sub-Conservancy Board, the entire organisation being under one Central National Conservancy. The Town Clerks of Liverpool and Manchester, Dr. Rumsey of Cheltenham, and Mr. Bailey Denton, gave evidence before the Commission to much the same effect. But none of these gentlemen, except perhaps the last, whose view was that "there is no other proper division of the country than watershed divisions" under the control of Conservancy Boards (Q. 4848), seem to

* First Report, page 20. Q. 223 *et seq.*

have looked upon these latter if erected as anything else than special boards formed for definite purposes of arterial drainage, water storage, and river protection. They did not contemplate their acting for all purposes of local government as what Mr. Tom Taylor called a "buffer" between the local and the central authorities.

Watershed areas impossible.

It is one argument against counties as intermediate areas that they are so various in size and population. But has anyone thought at all of the varying sizes of watersheds? The table given in the Appendix (*a*), which I borrow from Mr. Bailey Denton's evidence, is conclusive, I submit, of the impossibility of our looking, in these latter days, upon a "watershed area" as a practical factor of local government. For instance, the Thames and its tributaries pass through ten counties; the Trent and Derwent through seven counties; and the Cambridgeshire Ouse through nine counties. No divisions of the country such as these could be tolerated at the end of the nineteenth century, at the expense of all existing areas.

Constitution of Intermediate Authority.

County Justices nominees of the Crown.

For reasons which have already been discussed, the intermediate area must be the county. But if we were to make the present administrators of county matters, viz., the justices, into the "County Board" which is in everyone's mouth, and to the establishment of which both political parties are more or less committed, we should be met with the objection that the justices are in no sense delegates of the people. They are the last surviving relic of the feudal system in this country. They derive their power from the Crown itself, and the popular voice has nothing whatever to do with their appointment. Practically they represent but one class of the community—the landlords; and tenants and ratepayers have for years, almost for generations, been clamouring for a share in county government.

A good many proposals have been made as to the constitution of county boards. They have mostly attempted the grafting of such boards upon our existing system of local government, and were therefore foredoomed to failure. The erection of one unified local authority for each "primary area" makes the constitution of county boards easier. Notwithstanding the arguments which have been put forward for making these boards directly elective by the ratepayers, I am inclined to the belief

that a more sober and reflective administration of county matters will be achieved by making the members of the county boards delegates of the primary boards; *i.e.*, that each of the latter should choose a number of members for the county board, proportionate to the size and importance of its district, from among its own members or those ratepayers qualified to act as such. Mr. Goschen suggested in his Rating and Local Government Bill of 1871, that to delegated members of this kind should be added an equal number of magistrates chosen by the Quarter Sessions; and Mr. Sclater-Booth made a somewhat similar proposal in his County Government Bill of 1878, though he did not propose the development of the county board or any of her organisation. If it be necessary that there should be an infusion of the magistracy in these county boards, a point which is open to argument, but which is too complicated to enter upon here, then, I think, a proportion of one-third would be quite sufficient to to meet all views.

County Boards to consist of delegates from primary Boards.

Infusion of magistracy in County Boards.

Duties of County Authorities.

The duties of the County Board have next to be considered. In the first place, they would take over all the administrative business at present performed by the quarter sessions, except that of the control of the police, which being a department of the administration of justice, should be kept apart from the administration of the public health. The former is primarily a matter of Imperial concern, the latter is primarily a matter of local concern only. The purposes of the present county organisation are of two kinds, Imperial and local. Included in the first are: the maintenance of the peace, the reserve forces or militia, the administration of justice, including the control of the police, and parliamentary representation. Amongst the duties of local government now performed by the county magistrates, are: the management of bridges and main-roads, the control of lunatics, licensing of houses for the sale of intoxicating liquors, licensing of knackers and others, the execution of the Contagious Diseases (Animals) Act, including the inspection of dairies and milk shops, the regulation of weights and measures, the adulteration of foods and drugs, the registration of voters, and the control, by way of appeal or otherwise, of minor local authorities. All the duties of the second class would be transferred to the new County Board.

Purposes of present County administration.

But there are many additional functions which may properly be transferred to it. In the first place, I think that—much as the county has to provide and administer lunatic asylums—it should take up also the control of all workhouses and pauper infirmaries in the county, and administer in-door relief. I cannot myself see what essential connection there is between providing food and shelter for the poorest and weakest members of the community, and giving temporary medical or other relief to those suddenly struck down by sickness or misfortune. The proper organisation of what is now called the "poor law" is a subject of great complexity, which has exercised the minds of some of our best administrators. I cannot now go into details with reference to it, but it seems to me that its solution would be immensely simplified by a definite rupture of the two kinds of municipal assistance to the individual now known by the names of "in-door relief" and "out-door relief." The latter is a fair object for the consideration of the primary authority; the latter is a matter affecting more closely the county at large, and needing for its proper administration an area larger than that of the primary authority. There could not be a workhouse for each of these, and there must of necessity be combination. Let workhouses therefore be—as lunatic asylums are already—provided and administered by the county authority. Medical and other "out-door" relief would still remain in the hands of the primary authority, and, divested of its poor-law taint, might be made, under a judicious system of combination with provident dispensaries, a valuable means of encouraging self-help among the poor.

Additional functions for County Board.

In-door relief.

Workhouses.

Financially, too, this transference of in-door relief would be an advantage. Nothing is more anomalous or unfair than the poor law rating as at present practised. Let us suppose a town which, together with certain rural parishes around it, forms a poor law union. The town contributes by far the greater proportion of the paupers, but the incidence of the poor rate is not thereby made heavier on the town than on the rural parishes. All pay alike, so that the rural people help to lighten the poor law burdens of the urban. And to make the matter still worse, a farmer is rated upon a system that may make his assessment greater than his whole income, whilst a tradesman in the town probably pays only on a part of his income. These inequalities would be less severely felt if all in-door relief were transferred to the county boards; and the "workhouse test" which has so diminished out-door relief when

Unfairness of present Poor Law Rating.

Workhouse test.

guardians are in earnest about it, would tend to become more generally applied if the expenses of pauperism could be thereby shifted from their own shoulders to that of the county at large. The success of the Metropolitan Poor Fund under Mr. Hardy's Act of 1867 ought, I think to give us some encouragement in spreading the expenses of the maintenance of in-door paupers over a larger area than at present.

The present state of the highway law is very unsatisfactory. A bridge is under the control of the county; the roadway which it was erected to support is under the control of the highway board. "Main roads," a new class of highways invented in 1878, are under the care of highway authorities, but the county has to pay half the expense of their maintenance, and has also some general powers of control over highways. In the revised arrangements all main roads and the bridges over which they run should be under the definite control of the county board. All other roads and bridges should be under the local authority.

Control of main roads and bridges.

The county authority would also have to watch and from time to time to intervene in enquiries and legislation affecting watersheds, drainage, and rivers.

These are definite duties, in which there would be no possibility of overlapping of jurisdiction between the primary and intermediate authorities. Nicer questions would arise when a duty primarily devolving upon a local authority, such for instance as the provision of sewerage or of a proper water supply, was plainly beyond its unassisted powers. In such cases the county authority, which would be cognizant of these difficulties through the agency of its officials, to be presently referred to, should have power to combine two or more authorities for a definite sanitary purpose, and to apportion the expense of the necessary works amongst the jurisdictions concerned. Where one authority obstinately refused to join in a work that was plainly required, or denied facilities to its neighbour which it had no moral right to refuse, then the county board should have the power of coercing such local authority into doing what was necessary. Similarly, if a district was insufficiently supplied with schools, it should be the duty of the county board to see that the deficiency was corrected. Obviously this exercise of power would be less resented if coming from an elective board, in which the offending body was itself represented, than if emanating from a Government department.

Combination of primary authorities for special purposes.

Coercion of recusant authorities.

There is one function which should devolve upon county authorities on which I find it necessary to enlarge a little.

The supply of pure and wholesome water by a local authority to its constituents is of course of primary importance. But in casting about for sources of supply, authorities have not been particular to confine themselves to their own watershed, the yield of which fairly belongs to them, but have impounded supplies just where it happened to be convenient for themselves, regardless of the present wants or possible future needs of the districts included in the watershed. Practically there has been no one to say them nay; and an Act of Parliament once obtained, "vested rights" of the most uncompromising kind have been claimed and fought for in the law courts. It has even happened that a district to which a water supply captured by a great corporation properly belonged, at least in part, and whose area was traversed by the corporation water mains, has been refused any share of the water, on the ground that it was the property of the corporation, and none of it could be spared.

Watersheds and water supplies.

It must not be forgotten that there are other interests besides those of the local authorities and the water consumers to be considered and guarded. *Primâ facie* each district may be entitled to consume so much of the water found *within* it as may be necessary or convenient for its purpose. It may acquire the right to take the water, either by agreement with those who have the right over it, or by compulsory process by provisional order where those parties oppose.

But the taking of water from *beyond* the district is a question not merely between the water owner and the water consumer immediately at issue, but involves other, perhaps much wider, interests; and if public inquiry be necessary in cases where the local authority and the owner are at issue, much more is it needful to require vigilance on the part of some outside authority where those parties are agreed. True it may be that in many instances there might be no practical mischief in allowing the local authority to bargain without restriction, with the owner of neighbouring land or water, for its necessary water supply; but there must be other instances—*e.g.*, a proposed taking, by agreement, of water from another watershed within, or beyond, the district—where the exercise of such unrestricted power might operate to the serious prejudice of another district, perhaps adjoining, and perhaps even distant. It is impossible to anticipate by Statute Law the varying circumstances which may arise, and the consent of the county authority ought invariably to be obtained to the taking of water by a local authority for the purpose of public supply, power being given to the central authority, if the consent of the county authority

Taking of water from another watershed to be controlled by County Board.

should be withheld, to hear the parties interested, and to decide.*

Inquiry should be made in all cases.

The giving of this consent ought never to be a mere formality. The inquiring authority should order skilled investigation by its own officers into the whole circumstances of the watershed as regards sufficiency of supply for its own wants; and an unopposed petition for sanction should make it, if possible, more vigilant in ascertaining that the future interests of the community at large would not be prejudiced by its present consent.

County Authorities and Private Bills.

Reform of Private Bill Legislation.

It is a point worthy of consideration, whether county authorities could not relieve the Imperial Parliament from part at least of its incubus of private bills, if they were clothed with powers to authorize the construction of railways, canals, water-works, drainage, and other schemes affecting their county. The reform of private bill legislation is, like the reform of local government matters, a matter to which Parliament will have to give attention very shortly, and I do not propose to obscure my present issue by enlarging on this very fertile and suggestive topic. But I have thought it would be useful, as indicating the possibilities of a transference of some at least of the private bill duties of Parliament to the authority of each county, acting as a kind of local legislature, to take out the objects of the local bills which have been passed into law during the last four years. The result is as follows:—

	1882.		1883.		1884.		1885.	
	Bills.	Royal Assents	Bills.	Royal Assents	Bills.	Royal Assents	Bills.	Royal Assents
Public Acts	247	124	283	118	231	82	191	81
Private Acts—								
Railways	141	93	118	78	121	80	105	68
Canals and Docks and Harbours	24	20	21	17	23	15	15	7
Corporations	33	30	24	21	22	20	28	22
Gas and Water	36	31	22	16	24	17	24	21
Tramways	21	21	27	15	21	16	15	12
Miscellaneous	48	30	50	33	70	55	49	31
	303	225	262	180	281	203	236	161

* See on this subject the report of the Metropolitan Water Supply Commission, 1869, p. cxxiv.

Now as regards the gas and water and tramway schemes at least, the county authority would be likely to give as sound a decision as the chance agglomeration of four or five members of parliament, and those of necessity not the most enlightened or business-like. It is true that the latest writer on the subject, Mr. Frederick Clifford, expresses the opinion that "a change of tribunal from parliament to some outside tribunal, might, and indeed would, affect the character and weight of the decision, but would alter none of the other conditions which make existing procedure costly." * A rising and successful counsel at the parliamentary bar is, perhaps, hardly the most impartial judge on this question; and I leave the point open for the moment, with the expression of my strong opinion, derived from a very extensive experience of private bills of different kinds, that nothing could be more wasteful of time, strength, and money, than the present system of private legislation.

Wastefulness of present system.

Against Mr. Frederick Clifford, I may perhaps be allowed to put John Stuart Mill. Says Mill:

"It is but a small portion of the public business of a country which can be well done or safely attempted by the central authorities, and even in our own Government, the least centralised in Europe, the legislative portion at least of the governing body busies itself far too much with local affairs, employing the supreme power of the State in cutting small knots which there ought to be other and better means of untying. The enormous amount of private business, which takes up the time of Parliament and the thoughts of its individual members, distracting them from the proper occupations of the great council of the nation, is felt by all thinkers and observers as a serious evil, and, what is worse, an increasing one."†

This was said nearly a generation ago, when the procedure of Parliament was more leisurely and infinitely less fatiguing than at present. What would Mill have said of the new order of things, when almost everything is the subject of interminable wrangles and discussions, and Parliament is absolutely choked and paralysed by its own verbosity, and by its cumbrous and antiquated methods of procedure?

For the re-adjustment of the areas, debts and property of the primary authorities which would become necessary when the scheme of reform sketched out in this paper was brought into force, the county board would be responsible, being perhaps temporarily constituted for that purpose from delegates of the existing local authorities. This would ensure a hearing of all claims, and a settlement by one's own people, which

County Boards to re-adjust areas, debts, and property of Primary Authorities.

* "A History of Private Bill Legislation," page 260. (Butterworths, 1885).
† "Representative Government," page 266.

is always preferable to that of a stranger, as a government official must necessarily be.

There are some other matters which might properly come under the control of the county authority, such for instance as the decision as to "local option" with regard to the sale of intoxicating liquors in any area, the administration and supervision of the charities and charitable foundations of the county, and the like; but as I am addressing a Congress of sanitarians, and am looking at the question of local government reform more from the hygienic point of view, I do not think it necessary to do more than mention these.

Officers of Intermediate Authority.

Skilled officials of County Board.

It will have been pretty obvious from what has gone before, that I am contemplating the grouping of all skilled and technical officials round the county board. This will conduce at once to economy (because each primary authority could not provide an expensive staff for itself), to efficiency (because the county can afford to pay for the entire services of good men), and to continuity and symmetry (because the same official can be employed on all works of an identical kind). The superior officials that a county board would require for the proper management of its business would be the following:—

A *Secretary*, who should be a man of administrative ability and organizing power; not necessarily a lawyer, as the clerk of the peace would look after the legal business of the county.

An *Architect and Surveyor*, under whose care should be the county buildings, the roads, and the bridges. To him should be referred all plans for new public buildings and erections, such as hospitals, infirmaries, asylums, and the like; and he should possess the power of inspecting and reporting on the fabric and sanitary arrangements of all existing buildings of the kind. All technical points arising out of the passing by the "primary authority" of plans of new domestic houses should come before him.

A skilled *Chemist*, who should act as public analyser of all adulterated food and drugs, of all suspected water, of the purity of gas supplies, and of the pollution of the air by noxious trades. [In smaller counties these duties might be made over, as they are already in some large towns, to the medical officer of health].

A *Veterinary Surgeon*, to advise as to the contagious diseases of animals and the movement of flocks and herds in the county.

And lastly (and most important) a number—proportionate to

the size of the county—of *Superintending Medical Officers of Health.*

Before a mixed audience I should not be justified in enlarging, as I should otherwise be certainly tempted to do, upon the disgraceful and contemptible way in which the just claims of medical officers of health to recognition and security of tenure have been derided and set aside. Nothing is more anomalous in our present system of sanitary government than the position of the medical officers of health.

Present scandalous position of Health Officers.

When the appointment of health officer was first made obligatory upon local authorities, one Local Government Board inspector urged one plan in one part of the country, whilst another as strongly advocated a different plan. But local authorities were nearly always allowed to decide for themselves according to their own unassisted intelligence, and the consequence has been the most extraordinary jumble of health-officering that it is possible to conceive; a jumble of areas, a jumble of salaries, a jumble of terms and conditions of appointment; a jumble of everything.

Jumble of Health-Officering.

Some idea may be gained as to the variations of health appointments that at present exist from the following table, which I extract from the last Annual Report of the Local Government Board (p. cxix.):

Medical Officers of Health. [Note.—Authorities which choose to submit the appointments of their Health Officers to the (practically nominal) supervision of the Local Government Board, are entitled to claim half the salaries of these officers from the Imperial Treasury.]		Rural Sanitary Districts.		Urban Sanitary Districts.	
		No. of Authorities.	No. of Medical Officers of Health.	No. of Authorities.	No. of Medical Officers of Health.
Officers whose salaries are partly paid by Government.	Acting for the district of a single Authority.	297	297	385	385
	Acting for divisions of the district of a single (Rural) Authority	65	191	...	...
	Acting for the district or two or more Sanitary Authorities	142	44	170	45
Officers whose salaries are wholly paid by the Local Authorities.	Acting for the district of a single Authority.	29	29	225	225
	Acting for divisions of the district of a single (Rural) Authority	22	79	...	...
		555	640	780	655

Combinations of authorities which had with infinite trouble been got together, in order that an officer debarred from private practice and devoting himself entirely to his health duties might be appointed, have in quite a number of instances crumbled to pieces at the will of a cross-grained or ignorant constituent body. The greatest personal sufferer in all these cases was, of course, the medical officer of health, who had forsaken other avenues of professional advancement in the hope that he might find fame and honour in the paths of public medicine. Officers have been dismissed for speaking their minds with truth and freedom as to the sanitary evils they found around them, or their official lives have been made so intolerable that, like Mr. Shirley Murphy, there was no course open to them but resignation. Practically every officer, however tried and skilful, has been subjected to the trying ordeal of re-election at frequent, sometimes annual, periods, with the haunting fear ever present upon him, that some member of the local authority with whom the fearless performance of his duty had brought him in conflict, would compass his rejection or supercession. To these re-elections has lately been added a new terror. It has come to be the fashion for local authorities to re-elect their officers only on the condition of their accepting a diminution of pay. The Local Government Board have been making some futile protests against this growing habit; but it appears to be, nevertheless, extending.

Grievances of Health Officers.

One of the best and most energetic of health officers, Mr. H. E. Armstrong of Newcastle-upon-Tyne, remarked truly enough, in a recent address, that, "in the present state of opinion, and the perpetual conflict between private interest and public duty, the post of an earnest conscientious officer of health is one of devotion, danger, and self-sacrifice, scarcely justifiable considering the inadequate return he receives for it. His ever-increasing duties bring with them increasing anxiety and responsibility, and the need of additional effort without compensating benefit to himself. A practical exponent of virtue, which, according to Pythagoras, means to seek truth and to do good, he too often finds his conduct its own and only reward."

Clearly, health officers must be appointed on some more reasonable system; they must be safeguarded from capricious clippings of their already inadequate emoluments, and they must have greater security of tenure. This would be provided for by handing over their appointment to county boards, and by enacting that they were to hold their office on good behaviour, and to devote their whole time to their duties.

The functions of a superintending medical officer of health

might profitably include not only the present duties of disease-prevention and repression now contemplated by the official order of the Local Government Board, but also many other duties of a kindred nature, at present performed by different people, or not performed at all. For example, he should conduct and control the post-mortem examinations for coroners' inquests and other medico-legal inquiries, and direct investigations in the case of all suspicious uncertified deaths. He should act as medical assessor or referee in obscure or disputed cases, sanitary or medico-legal, which require forensic adjudication. He should act as inspector of burial grounds, and advise the county board as to their closure when necessary. He should be empowered to inspect factories, workshops, bakehouses, dressmakers' establishments, and all other workplaces, as to their sanitary condition and the health of the employés. He should inspect the sources and take measures for safeguarding the purity of water supplied to urban communities, examine and report on the supplies of gas, the management of alkali and other chemical works, the arterial drainage of river valleys within the county, and the prevention of smoke and other noxious vapours in towns and populous districts. Generally, in fact, he should afford skilled medical assistance in all the branches of local government which may require it.

Functions of Superintending Medical Officers of Health.

In this connection I think it may be useful to reprint (see Appendix B.) the substance of a very exhaustive memorandum which was prepared by the late Dr. Rumsey (one of the earliest and clearest-headed of sanitary reformers), for the purposes of a memorial which was presented in May, 1868, to the Lord President of the Council, the Home Secretary, and the President of the Poor Law Board, by a joint committee of the British Medical and Social Science Associations, of which I had the honour of being a medical member.

Dr. Rumsey's memorandum on State Medicine.

This Joint Committee was appointed in 1866 to promote a better administration of the laws relating to registration, medico-legal inquiries, and the improvement of the public health. Under the fostering care of Drs. Rumsey and A. P. Stewart, who are unhappily no longer with us, and of Messrs. W. H. Michael and W. Clode, whose wise counsels we are fortunately still able to command, the committee took a foremost share in shaping and guiding public opinion on sanitary matters, and it was directly instrumental, through its memorial of the 22nd of May, 1868, in procuring the appointment of the Royal Sanitary Commission. For several of the ideas which I have developed in this

The Joint Committee on State Medicine.

paper I am indebted to the labours of that committee, and although it has for several years ceased to have any organized existence, I should like to take this opportunity of calling attention to the excellence and thoroughness of the work which it accomplished.

The annual reports of the secretaries are amongst the most remarkable papers on State Medicine with which I am acquainted; and the zeal with which, during its period of office, the Joint Committee plied the ministers of the period with deputations and memorials is worthy of all praise in these latter days, when we are accustomed to think that we ourselves are the only people that have discovered the deficiencies of local government. As a specimen of several such, I take leave to reprint in Appendix C. a memorial presented by the Joint Committee to Lord Beaconsfield in June, 1877 (unhappily with but little practical effect), on the subjects of the unification of the sanitary law, the establishment of county boards, and the remodelling of the public health medical service. This memorial sums up as succinctly as it is possible to state them, many of the arguments which I have in the course of this address attempted to elaborate.

"Little dabs of doctoring."

A study of Dr. Rumsey's memorandum and the Committee's memorial will serve to convince the most casual reader of the very fragmentary manner in which local medical agency is even now managed. The "little dabs of doctoring" of which Mr. Simon spoke so caustically thirty years ago* still endure, in an even accentuated form.

With the exception of a change of tense and a little shortening, I have left Dr. Rumsey's memorandum pretty much as it was, indicating in the margin the points on which the agency employed has been varied or improved since the memorandum was written, now 17 years ago. No one who reads these papers can fail to perceive how imperfectly the objects desired by the Joint Committee have been met by subsequent legislation. And here I must leave for the present the very important and pressing question of the appointment, duties, and tenure of office by Medical Officers of Health.

THE CENTRAL AUTHORITY.

The functions and attributes of the Central Authority need not detain us long. One thing is certain: it must not take upon itself the actual work of local government; it must be advisory and

* Minutes of Evidence of Select Committee on Adulteration of Food. (Q. 806). 1855.

admonitory, but not administrative. It must steer clear of the rock on which the General Board of Health was wrecked: for so completely is self-government the habit and quality of Englishmen, that the country would resent any central authority undertaking the duties of the local executive. The views of the Royal Sanitary Commission as to the functions of the central authority may perhaps be usefully reproduced:—

Functions and attributes of Central Authority.

"To keep all local authorities and their officers in the active exercise of their own legally imposed and responsible functions; to make itself acquainted with any default and to remedy it; to direct enquiries, medical and otherwise; to give advice and plans when required; to sanction some of the larger proceedings of the local authorities; to issue provisional orders, subject to Parliamentary confirmation; to receive complaints and appeals; to issue medical regulations on emergencies; and to collect medical reports." (Second Report, vol. i., p. 36.)

I do not know that the true positions which the local and central authorities should bear to one another have been anywhere so clearly and succinctly stated as by Mr. Mill, whose views I have so often echoed in the course of this address. At the risk of twanging always on the same string, I transcribe his remarks on this subject also:

Mill's views on the question.

"The authority which is most conversant with principles should be supreme over principles, while that which is most competent in details should have the details left to it. The principal business of the central authority should be to give instruction, of the local authority to apply it. Power may be localized, but knowledge to be most useful must be centralized; there must be somewhere a focus at which all scattered rays are collected, that the broken and coloured lights which exist elsewhere can find there what is necessary to complete and purify them. . . . . The central authority ought to keep open a perpetual communication with the localities; informing itself by their experience, and them by its own; giving advice freely when asked, volunteering it when seen to be required; compelling publicity and recordation of proceedings, and enforcing obedience to every general law which the legislature has laid down on the subject of local management. That some such laws ought to be laid down, few are likely to deny. The localities may be allowed to mismanage their own interests, but not to prejudice those of others, nor violate those principles of justice between one person and another, of which it is the duty of the state to maintain the rigid observance. . . . . As an adviser and critic, an enforcer of the laws, and a denouncer to Parliament or the local constituencies, of conduct which it deems condemnable, the functions of the executive are of the greatest possible value."—"Representative Government," pages 283-5.

LOCAL FINANCE.

I have left until the last, partly because of its intricacy, and partly because of its importance, the question which will after

all compel attention to local government, if nothing else will: and that is the very alarming condition of local finance. It is no part of my present purpose to analyse the rapid increase of local taxation, and of the indebtedness which, in so *debonair* a fashion, is being piled up by the present generation for the next to repay. It is, however, impossible to doubt both taxation and indebtedness would be decreased by the unification of area and authority which I propose, since the present superfluous machinery and consequent increased expense would be saved, and the local budget could be more efficiently controlled where it was set before those concerned in an intelligible way.

Alarming condition of Local Finance.

To quote Mr. Rathbone again:—

"At present it is impossible to ascertain the total amount of local taxation at any given moment, because all the returns are much in arrear, and because the returns sent in by different authorities are not made up to the same date. It is impossible to compare with any certainty the expenditure in rural and in urban districts, because the boundaries of unions and parishes intersect the boundaries of boroughs and local board districts. It is impossible to determine the proportions in which the county expenditure is charged on boroughs, on local board districts, and on rural places, or the proportions in which the school rate is charged upon local board districts and upon rural parishes partly included in them. It is impossible to furnish an accurate statement of ordinary income and expenditure within urban sanitary districts and for purposes merely urban, partly because the capital expenditure on sewers, on streets, on gasworks and waterworks, is not distinguished from the recurring annual expense of maintenance and supply, partly because places which provide their own gas and water are not distinguished from those in which they are supplied by private enterprise. Finally, it is altogether impossible from the accounts of twenty-three several kinds of local authority, all differently constituted, all presiding over areas which often overlap or interlace, using different periods of account and levying rates or contributions on different bases and on different valuations, to extract any clear budget of local finance, to know exactly the total annual income or expenditure or the total indebtedness of the local government of this kingdom, or to compute the proportion which these several sums bear to one another in the same year, or to themselves in former years." *

I print in Appendix D, for the information of those who may care to study the question in detail, a comparative view of the receipts and expenditure of local authorities at the date when Mr. Goschen made his famous report of 1870, and at the present time, or at least as closely to the present time as the cumbrous machinery of the Local Government Board permits. Two intermediate periods are also printed for comparison. A great many *caveats* would have to be made in instituting comparisons between these four

Growth of expenditure since 1868.

* *Nineteenth Century*, February, 1883.

sets of figures, since more and more authorities have been prevailed upon to make returns, and the earlier and later figures are not, therefore, strictly comparable. But making all allowances, the increase of expenditure in the short period of fourteen years from £30,000,000 to £54,000,000, or 80 per cent., is sufficiently startling. In 1868, the rateable value of England and Wales was £100,668,000, having increased from £51,898,000 in 1815.* In 1882–3 the rateable value was £141,407,000, or an increase of 40 per cent. So that in the period under review the growth of expenditure has been twice as rapid as the growth in value of the property subject to local taxation.

Growth of Expenditure twice as great as of Rateable Value.

I cannot pursue this comparison further, but may perhaps usefully give for reference the sources from which the receipts were derived at these two periods:

1868–9. [Mr. Goschen's Report, Appx., Pt. III., Tab. V.]		1882–3. [Parliamentary Paper No. 209, 1885, p. 10.]
£16,223,000	Receipts from Rates	£24,477,000
1,225,000	Government Grants	3,182,000
4,363,000	Tolls, Dues, Rents, &c.	4,691,000
2,874,000	Miscellaneous	10,389,000
5,453,000	Loans	10,958,000

Growth of Local Indebtedness.

But the growth of expenditure is not in itself the worst feature of the returns. So long as the expenditure of the year was fairly met out of current receipts, no great permanent harm might happen. But we are year by year drawing bills upon the future to an increasing amount, and are availing ourselves of loans for the purposes of making both ends meet to a far greater extent than we pay off old scores.

Local Governing Bodies sinking deeper and deeper into debt.

The local indebtedness of the county was returned in 1870-1 as £38,250,000, but practically no reliance is to be placed upon the figures as to outstanding loans given in the years before 1874–5. At the end of that financial year, the outstanding loans of local authorities amounted to £92,820,000. By 1878-9 they had expanded to £128,190,000, and in a second interval of four years, viz., by the 31st March, 1883, they had further risen to £159,140,000. In eight years, therefore, local indebtedness increased by more than 66 millions, or over 71 per cent., being an average increase of £8,300,000. If from this amount be

Local Indebtedness increased 71 per cent. in 8 years.

* Appendix to Mr. Goschen's Report on Local Taxation, 1870, Part II., Table VII., B.

deducted the average annual amount of the loans raised by the local authorities during the same years, the average annual amount repaid would appear to be £4,672,000, or 36 per cent. of the amount borrowed.

The following table gives the exact figures for each of the years in question :—

Year.	Amount of New Loans raised.	Amount of Loans Outstanding.
1874-5	£11,917,288	£92,820,100
1875-6	£10,115,535	£99,407,540
1876-7	£12,057,007	£106,045,465
1877-8	£14,367,880	£114,412,201
1878-9	£14,565,052	£128,189,589
1879-80	£13,980,729	£136,934,070
1880-1	£13,351,935	£144,203,299
1881-2	£15,351,914	£151,704,640
1882-3	£10,957,601	£159,142,926

Thus the total amount of new loans raised in these years amounted to £116,665,000, equal to an average of £12,963,000 per annum.

I give in Appendix E a table showing the outstanding loans of the more important classes of local authorities, together with the population and valuation of the country, at the end of each of the last seven years. As might be expected, the largest amount of indebtedness has been incurred by town councils and local boards for sanitary purposes. The loans of urban sanitary authorities increased from £41,539,549 in 1877 to £72,378,929 in 1883; and during the same time the loans of School Boards rose from £5,456,361 to £12,818,861.

Local Debt is approaching dimensions of National Debt.

It may be worth while in this connection to compare the respective amounts of our National Debt and Local Debt, in 1883 and eight years previously. In the year 1875 the National Debt of the United Kingdom was 772 millions, whilst the local debt of England and Wales was 93 millions. By 1883 the National Debt had diminished to 756 millions, or a decrease of 16 millions; whilst in the same eight years the local debt had expanded to 159 millions, or an increase of 66 millions.

It stands, of course, to reason that the claims upon local authorities have of late years tended to increase very largely in number and amount. But these figures cannot be looked at with complacency. Nor would they be so regarded by the community at large, which busies itself little with local taxation returns two

Local Budgets should be brought before Parliament and before Ratepayers.

and sometimes three years old, if the local budget were brought before Parliament * in the same way that the National Budget now is, and if local accounts were submitted to every ratepayer on the debtor and creditor principle of a joint-stock company's report. If a citizen were told frankly that the total of his rates was six and eightpence in the pound, and that the amount of the local indebtedness of his district was equal to its rateable value for three whole years, he would probably bestir himself to see that the local finances were got under better control, and put on some sounder footing. At present local indebtedness is so broken up and is incurred under so divided a responsibility that its growth, which can only be checked locally, is not known locally, and could not be effectually resisted even if it were.

Local Taxation.

Incidence of Local Taxation.

To attempt to discuss the incidence of local taxation would be impossible for me with the time at my command. Moreover, there are so many intricate questions of local and imperial needs and requirements mixed up with it, that I think it best to confine myself to the truism that there should be an uniform assessment of all real property for purposes of all rates and taxes, whether local or imperial, and an unification of all the rates at present levied at different times and on different systems. At present there may be three different assessments—by the union, the county, and, if it thinks fit, the borough. There are the poor rate, the highway rate, the borough rate, the general district rate,

Rates.

and the county rate, for the collection of each of which a separate machinery is or may be employed. Each authority makes up its own accounts in its own way and for its own periods. Prior to 1877 there were nine different dates to which the accounts of local authorities were made up

Rendering of accounts.

in the Local Taxation Returns. One of these nine dates was "the year last ended previous to June," which obviously lent itself to 365 possible permutations. Since then the Local Government Board has succeeded, under an Act of 1877 (40 and 41 Vict., c. 66), in getting most of the local authorities under its own immediate control to make up their returns to the 25th March. The accounts of the metropolitan vestries and district boards, of sewer autho-

* This *was* done on one or two occasions some years ago. It ought to be made a rule.

rities, of drainage, embankment, and conservancy authorities, of markets and fair authorities, of bridges and ferries authorities, and of harbour authorities, are, however, still made up to "the year last ended previous to June"; those for Church rates are made up to Easter-Day; those of the City of London, the Metropolitan Board of Works, and Pilotage Authorities to the 31st December; and those of the Commissioners of Sewers to the 29th September.

At present the complete unification of rates cannot be carried into effect because the general district rate exempts railways, agricultural land, and canals, to the extent of three-fourths, whilst the poor-rate and other rates admit of no such exemption. Inquiry is needed as to the justice or injustice of this exemption, but meanwhile the rates might at least be consolidated into two, or better, into one divided into two parts; one with the exemption, and the other without. There would be this further advantage in the latter plan, that the second half of the rate would represent substantially the same thing as the existing poor and borough rates, on which the parliamentary and municipal franchises are based.

Consolidation of Rates.

Probably to the County Board must be given the control and direction of valuation for the purposes not only of whatever rate may represent the existing county rate, but also, if rates are to be consolidated, of all rates and contributions; and it will be one of its most important and difficult functions to see that the existing inequalities and discrepancies in valuation in different unions are removed. The disbursement of rates in each unit should be under one control and subject to one audit, and accounts of the receipts, disbursements, and liabilities should be prepared and published on one uniform plan throughout the country, and for the same period of account.

Valuation.

Expenditure must be under one control.

Another reform, based upon both official and business experience, may here be mentioned. Every local authority and every county board should be required to prepare and to publish for general information, full and precise estimates of its proposed expenditure for the coming year, as is already required of communes and departments in France. This would be a very important check upon waste and extravagance, and would afford to every ratepayer the opportunity of familiarising himself with the return he gets for his money. The Annual Balance Sheet should also be prepared, and when officially audited, published in the local newspapers for general information. This publication should not be optional with the local authority, but compulsory. It is most important that the

Estimates of proposed expenditure.

Annual Balance Sheet.

fullest publicity should be given to everything connected with the finance of local administration. At present, any information on the subject is only obtainable with difficulty, and the annual accounts are nearly always—except in some well-administered boroughs—highly complicated and unintelligible.

Treasury Subventions to Local Rates.

Treasury subventions to Local Expenses.

There is one other point connected with local finances upon which I feel it incumbent to say something, viz., the question of treasury subventions to local authorities. Nothing which has grown up as some particular grievance, cuold be less systematic than the present system, made itself articulate, and a weak ministry has throttled its voice for the moment by a sop in the shape of a parliamentary grant. The cry is always for more money from the government, under the mistaken impression that this means someone else will have to find it, and you will not. To scatter money as at present amongst a multitude of petty authorities, for a number of widely different objects, is simply to encourage its waste.

The total amount of Treasury Subventions, according to the latest obtainable figures,* was £2,391,090 in 1882-3, distributed as follows :—

Poor Law Authorities ... ... [Medical Officers' and Schoolmasters' and Schoolmistresses' salaries; Maintenance of Pauper Lunatics; Additional Fees to Registrars of Births and Deaths.]	£647,508
County Authorities ... ... [Police, £423,908; Lunatic Paupers chargeable to Counties, £16,012; Criminal Prosecutions, &c., £154,226.]	£594,146
Municipal Corporations ... ... [Pay and Clothing of Police, £374,762; Prisoners, £48,346; Lunatics chargeable to Boroughs.]	£423,666
Urban Sanitary Authorities (including Town Councils acting as such) ... ... [Grants for salaries of sanitary officers and for main roads.]	£72,792
Rural Sanitary Authorities ... ... [Grants for salaries of sanitary officers and for main roads.]	£43,606
Port Sanitary Authorities ... ... [Salaries of sanitary officers.]	£564
Carried forward.....	£1,782,282

* The local rates paid on Government property—a source of receipt of recent date—are also omitted, as properly belonging strictly to the locality. The rates paid by Government in this way amount to about £160,000.

Brought forward ...	£1,782,282
Metropolitan Board of Works ... . [Government contribution to Fire Brigade.]	£10,000
Commissioners of Police for Metropolis ... ... [Salaries of Commissioners, &c., and contribution on assessed rental.]	£486,582
Corporation of London ... ... [Various.]	£3,913
Highway Authorities in Rural Districts ... ... [Towards expenses of main roads.]	£108,313
Total	£2,391,090

I have omitted * from this account (as it is left out from this column in the Local Taxation returns), the item of £790,988 received by school boards as grants in aid of elementary education. Strictly speaking, this is of course a Treasury subvention also; and if added to the above it would raise the total grants from the nation towards the relief of local taxation to £3,182,078. But inasmuch as the promotion of the national education is a truly Imperial object, it will be just to regard the cost of elementary schools as an expense in which it is proper that the nation as a whole should bear a substantial share.†

School grants.

But none of the other subjects for which money is now granted by the State appear to me to stand on the same footing, and if every one of the subventions were withdrawn, I think no injustice would follow, provided some tax of equivalent or nearly equivalent amount now paid into the national treasury were handed over to the local authorities. Now we have fortunately an impost ready to our hand for this purpose in the Inhabited House Duty. A tax on inhabited houses was first imposed in 1696, but this was repealed in 1834. The tax was re-imposed with some alterations in 1851, when the duty on windows was discontinued, and it has been levied on the revised basis ever since. Houses under £20 in value are exempt;

Present subventions to be compounded for by House Tax.

* Local Taxation Returns (England). Year 1882-3. Parliamentary Paper No. 444 of Session, 1884.

† The total receipts of School Boards for the year 1882-3, excluding loans, were £3,157,719, of which £1,837,567 was raised by rates, £479,645 was received in fees, £790,888 was granted by the Education Department, and £49,619 was received from miscellaneous sources.

houses occupied partly for purpose of trade and partly as dwelling houses are charged 6d. in the pound of rateable value; and ordinary dwelling-houses are charged 9d. in the pound. The receipts from this impost have enormously increased of late years. In 1854–5 the receipts were £650,241; in 1864–5, £916,806; in 1874–5, £1,380,770; and in 1884–5, £1,855,292.*

House Tax really a local impost.

It was one of the proposals of the Government Rating and House Tax Bill of 1871, that this particular tax—which is indeed, in its essence, more of a local than a national impost—should be handed over to, and levied by, local authorities. (Clause 2.) Mr. Gladstone has expressed himself emphatically averse to the system of state subventions of the present kind; and I submit that they are bad in principle and mischievous in practice. I should see great advantage in the compounding once and for all of these sops to local clamour, by a tax like the house-tax, which is practically their equivalent in amount, and is incomparably a more legitimate source of local revenue than the payment of a sanitary officer, for example, is a matter for Imperial subsidy.

CONCLUSION.

I have now finished this long—necessarily long—explanation of the reforms which appear to me to be required to bring local government into its proper position as one of the most important organisations in the country. My main propositions admit, however, of being very concisely stated. They are the simplification and unification of the primary area; the creation of one authority for all local business, and only one; the creation of county boards; the reorganisation of the staff of local government officials, and the consolidation of local finance.

Reforms necessary.

Let me, paraphrasing the words of the Royal Sanitary Commission, give expression, by way of conclusion, to my profound conviction that no system of administration, however complete in theory, upon a matter of such importance and complexity as

* Twenty-eighth Report of the Commissioners of Her Majesty's Inland Revenue, for the year ended 31st March, 1885 (C. 4474 of Session, 1885), Pages 86-7.

Men of character and intelligence must take part in Local Government.

the health and well-being of the community, can be expected to attain its object, unless men of superior character and intelligence throughout the country feel it their duty to come forward and take part in its working. The system of self-government, of which the English nation is so justly proud, can hardly be applied with success to any subject, unless the governing bodies comprise a fair proportion of enlightened and well-informed minds. A more vigorous and intelligent public opinion on local government has yet to be created in many places, and until it is created the action of the authorities will be more or less hesitating and inconsistent. Many questions of vital importance are from their very nature incapable of being completely provided for by any amount of legal enactment, however minute and explicit. So large a discretion must of necessity be left to local authorities as to details, that in practice much will always depend on the energy and wisdom of those who compose such authorities. Moreover, there are limits to the power of any central authority to remedy the evils produced by local inefficiency. It may control, stimulate, and in some cases supplement the efforts of local bodies, but it cannot be a substitute for them. It seems therefore peculiarly incumbent on those who have leisure to take their share in administering local government. In this work not only will prejudices have to be overcome and inactivity quickened to exertion, but a sound judgment must be exercised as to the extent to which, and the limits within which, considerations of public welfare ought to interfere with the absolute rights of private owners of property, and even with the personal liberty of individuals. It is work therefore which cannot be performed without effort; but it ought to be, and let us hope that it will be, zealously undertaken, now that Parliament and the nation is becoming alive to the importance of the subject.

APPENDIX A. (See Page 313.)

[From page 271 of the First Report of the Royal Sanitary Commission.]

Tabulated statement of the principal Rivers of England and Wales, of which the Catchment Basins or Watershed Areas exceed in extent 250 square miles.

Name of River.	Length of Main Channel in miles.	Number of Tributaries.	Total length of Tributaries in miles.	Extent of Area in square miles.	Number of Counties Intersected.	Principal Town within the Area.
Arun, Sussex	51½	...	.....	349	3	Arundel.
Avon, Somerset	78½	4	59¼	869	3	Bristol.
Avon, Wilts	67	1	28¼	666	2	Salisbury.
Blackwater, Essex	50	2	53	465	1	Chelmsford.
Bure, Norfolk	52¼	1	11¾	338	1	North Walsham.
Dee, Cheshire	93	4	82½	850	5	Chester.
Derwent, Cumberland	35½	1	13¼	268	1	Cockermouth.
Dovey, Wales	35	5	44½	264	2	Machynlleth.
Eden, Cumberland	70½	4	97½	916	2	Carlisle.
Elwy, Clwyd, Wales	31½	3	50	306	2	Denbigh.
Exe, Devon	58½	5	82	562	2	Exeter.
Humber (Ex, Ouse & Trent)	37	2	55¾	1229	2	Hull.
Lune, Lancashire	53½	2	30¾	434	3	Lancaster.
Medway, Kent	69	3	62½	997	3	Maidstone.
Mersey	68	6	187½	1706	3	Liverpool & Manchester.
Nen, Northamptonshire	99	1	11	1055	3	Northampton.
Orwell, Suffolk	35	...	.....	257	1	Ipswich.
Ouse, Yorkshire	59½	10	580	4207	2	York and Sheffield.
Ouse, Cambridgeshire	156¼	8	212½	2894	9	Lynn and Cambridge.
Parret, Somersetshire	38½	4	106	561	2	Bridgewater.
Ribble, Lancashire	61	3	72½	501	2	Preston.
Rother, Sussex	33½	...	.....	281	2	Battle.
Severn (Exe, Wye)	178	17	453½	4437	8	Glo'ster & Shrewsbury.
Stour (Essex)	61¾	2	33¾	420	2	Manningtree.
Stour, Kent	52¾	1	12	291	1	Canterbury.
Stour, Dorset	64	2	25	479	3	Blandford.
Tamer, Devon	55¾	2	31¾	381	2	Launceston.
Tees	95	10	132	744	3	Darlington.
Teifi, Wales	70	4	30	389	3	Cardigan.
Test, Hants	35¼	1	6¾	544	2	Romsey.
Thames	201¼	15	463	5162	10	London.
Torridge, Devon	52½	2	30	349	1	Torrington.
Towy, Wales	66½	3	55	522	3	Caermarthen.
Trent and Derwent	232	13	331	3972	7	Stafford, Birmingham, Leicest'r & Nottingh'm
Tweed	22	1	30	267	2	Berwick.
Tyne	35	6	154½	1053	2	Newcastle.
Usk	76¼	7	107	650	2	Newport & Pontypool.
Waveney, Norfolk	58¾	...	.....	339	1	Yarmouth and Beccles.
Wear, Durham	70	5	66¼	455	1	Durham.
Welland, Northampton	72½	3	78	707	2	Stamford.
Witham, Lincoln	89	4	75	1052	1	Lincoln.
Wye, Hereford	148	9	223	1655	6	Hereford.
Yare, Norfolk	35	4	84	533	1	Norwich.
Chichester, Hayling and Portsmouth Creeks	.....	...	.....	315	...	

These river basins or watershed areas amount to 44 in number, and comprise more than four-fifths of the whole surface of England and Wales. The remaining river basins descending to streams only three miles long are 143 in number, and vary in size from 2,000 acres to 136,000 acres. Of these, 39 streams exceed 65,000 acres in extent, and the whole (143) do not cover one-fifth of the surface of England and Wales.

APPENDIX B. (See Page 323.)

EXTRACTS FROM MEMORANDUM ON STATE MEDICINE, prepared by DR. RUMSEY, and submitted to Her Majesty's Ministers by a Deputation from the Joint Committee of the British Medical and Social Science Associations in May, 1868.

The Joint Committee asked for a thorough, impartial, and comprehensive Inquiry into the operation of the several Laws, Regulations, and Customs, under which Members of the Medical Profession were employed, constantly or occasionally, in Towns and Rural Parishes,—by different departments of Government, by Public Bodies, by Local Authorities, or in Voluntary Societies; or under which Medical Practitioners acted as Witnesses in Courts of Law and Medico-legal Inquiries, or otherwise;—for any of the following objects and purposes:

		KIND OF AGENCY NOW EMPLOYED.
Mortuary Registration.	1. To give information concerning the CAUSE OF DEATH, by certificate to the Registrars of Deaths and by evidence at Coroners' Inquests.	Local Practitioners.
Medico-legal Inquiries.	2. To perform *post-mortem* examinations and analyses, in suspicious or obscure cases, for the information of Coroners and Courts of Law.	Local Practitioners or Special Experts.
Medical and Scientific Observations.	3. To record and report, periodically, the number and nature of all cases of SICKNESS (diseases and injuries) attended at the Public Expense, with their causes and results; and more minutely and frequently during outbreaks of Epidemic disease; to observe and record meteorological and other physical phenomena; to note, investigate, and report outbreaks of Epizootic and Epiphytic diseases, and any exceptional and important local facts of animalcular, parasitic, fungic, or other like, invasions.	Voluntary enterprise of local practitioners in a few towns. [Returns of sickness attended by Poor Law Medical Officers are now pretty generally sent to Medical Officers of Health, but they are not of much use.]
Medico-Sanitary Inquiries.	4. To investigate and report, on particular occasions and in selected places, facts and circumstances relating to the prevalence of disease, —especially of Epidemics.	Inspectors under Privy Council. [Now Local Government Board].
Interments.	5. To inquire into the condition of Burial Grounds, and to superintend the execution of laws and regulations for the BURIAL OF THE DEAD.	Inspectors under Home Office.

MEMORANDUM ON STATE MEDICINE—*Continued.*

		KIND OF AGENCY NOW EMPLOYED.
Advice and Aid to Authorities.	6. To afford advice and aid to Local Authorities in matters relating to the Public Health; especially as to the avoidance and removal of Causes of disease, and the condition and sanitary regulation of Common Lodging Houses and the Dwellings of the Poor.	Officers acting under Local Boards in certain places. [Every sanitary district has now a Medical Officer of Health.]
Sanitary Measures, Vaccination, &c.	7. To inquire into and report upon the Local Administration of Laws for the prevention of disease and mortality; for instance, the extent and efficiency of proceedings under the Nuisances Removal Acts; the progress, performance, and results of Vaccination, &c.	Inspectors under Privy Council. [Now Local Government Board].
Workhouses, Medical Relief and Charities, &c.	8. To inquire into and report upon the sanitary condition and management of Workhouses; and to inquire into the administration of Medical Relief to the Poor, in Districts and Workhouse Infirmaries,—also in Medical Charities and other Public Institutions.	Inspectors under Poor Law Board* and Privy Council. [Now Local Government Board Inspectors].
Asylums, &c., for the Insane.	9. To inquire into and report upon the condition and management of Asylums, Hospitals, Licensed Houses, and lodgings, for the reception and treatment of the Insane.	Commissioners in Lunacy, Chancellor's Visitors, County Visiting Physicians, and District Medical Officers.
Prisons, &c.	10. To inquire into and report upon the sanitary condition and management of Prisons, Reformatories, and other corrective establishments.	Inspectors under Home Office.*
Schools, &c.	11. To inquire into and report upon the sanitary condition and management of Elementary Schools and other places for the education and industrial training of the Young.	Inspectors under Privy Council.* [Education Department.]
Occupations, &c.	12. To examine and report on the sanitary condition and the protective regulations of Mines, Factories, Potteries, Bake-houses, Dressmakers' establishments, and all other Work Places, under various Enactments for the control and regulation of LABOUR.	Inspectors under Home Office,* Certifying Surgeons and officers under local authorities.
Food and Drinks.	13. To examine into the purity, genuineness, and wholesomeness of Articles of FOOD AND DRINK, supplied to the community, or to particular classes or public establishments; and to perform chemical analyses and microscopic examinations for the detection of Poisons and Adulterations.	Officers (sometimes Analytical Chemists) under local authorities, or County Magistrates, in a few places. [Analysts now appointed in all Boroughs by Corporations, otherwise by County.]
Water Supply.	14. To examine into and report upon the WATER SUPPLY of towns and villages, and the condition of rivers and streams.	Officers under local authorities, in some places. [Now universal.]

MEMORANDUM ON STATE MEDICINE—*Continued.*

		KIND OF AGENCY NOW EMPLOYED.
Gas, Smoke, and Chemical Works.	15. To examine into and report upon the supplies of Gas, the management of Alkali (and other Chemical) Works, and the prevention of Smoke and other Noxious Vapours, in towns and populous districts.	Officers under local authorities. Inspectors under Board of Trade. [Now Local Government Board instead of Board of Trade.]
Animals.	16. To inspect, with or without the aid of scientific Veterinarians, the ANIMALS intended for human food; —to report and advise upon the manner in which such animals are kept and fed, conveyed by land or sea, and imported; and to assist in carrying into effect any Government regulations on these matters; —and to examine into and report upon the condition of Slaughter-houses, Cow-houses, Stables, Pigsties, etc., etc.	Officers under local authorities in a few places. [Now universally]. Officers under Privy Council in certain cases. Custom House Officers.
Imported Diseases.	17. To superintend and aid the execution of measures for preventing the Importation of Foreign Pestilence at Sea Ports; for regulating the sanitary condition of Ships; and for protecting the health of sailors and passengers.	Quarantine Officer under Privy Council Officers under local authorities.
Medico-legal Certificates.	18. To investigate and certify the condition—physical or mental—of persons accused of crime, or needing legal protection, or demanding compensation for personal injury,—or whose competency to fulfil any social or family duty, or labour-contract, becomes the subject of legal inquiry,—and to determine the fitness of children and young persons for work. [*Under this head would be included Certificates of Insanity, and the duties of Certifying Surgeons, under various Factory and Labour Enactments.*]	Any Registered Medical Practitioner. Special Experts. Certifying Surgeons
Forensic Evidence.	19. To give medical or scientific evidence on any of the preceding matters in Courts of Law.	With few exceptions, those marked with asterisk (*) are not medical.

II. The Joint Committee suggested that—while many of the Provisions and Arrangements, described under the preceding head, were of merely partial, occasional, and exceptional application—there were several other objects, then wholly unaccomplished, as to which legislative action was urgently required, and for the proper fulfilment of which, as also for the purposes

before mentioned, the appointment of skilled Medical Officers in Districts would be found necessary;—for example:—

1. *Registration.*—To examine and revise all Registers of Births and Deaths, in Registration Districts; to verify the Fact of death in certain cases; to investigate and record accurately, in all uncertified or doubtfully certified cases, the Cause of death.

2. *Medico-legal Inquiries.*—To bring special knowledge and experience to the conduct, under authorized rules, of *post-mortem* examinations for Coroner's Inquests or other Medico-legal Inquiries; and to examine before burial the bodies of Infants alleged to be still-born.

3. *Forensic Medicine.*—To act as Medical Assessors or Referees in obscure or disputed cases—sanitary or medico-legal—which require Forensic adjudication.

4. *Interments, Mortuaries, &c.*—To advise and assist Local Authorities in carrying into effect regulations for the removal and burial of the dead, especially in crowded populations and in times of pestilence or great mortality; and to inspect Mortuaries or other places for the reception of corpses before burial.

5. *Dwellings.*—To advise and aid Local Authorities, Building Societies, and other public companies, in regulating the Site, Construction, and sanitary arrangements of Dwelling Houses, especially of those proposed to be erected for the Poor, and to certify the satisfactory completion of such undertakings.

6. *Venereal Diseases.*—To direct and aid the execution of Measures concerning the health of Women, within the meaning of the Contagious Diseases Prevention Act, 1866.

7. *Pharmacy.*—Aided by skilled Pharmacians or scientific Chemists, to inspect establishments for the sale and preparation of Medicines, and to detect Adulterations of Drugs.

8. *Medical Police.*—When directed by a proper authority, to inquire into and report upon offences against the Medical Act, especially "infamous conduct in any professional respect" of medical practitioners, in their respective districts.

9. *Nurses and Female Midwives.*—To inquire into the qualifications of Midwives and Nurses, in the same districts; and to aid in carrying into effect any Law which may be enacted for the Examination and License of Women intending to act in such capacities.

[Nos. 4 and 5 of these points may be said to have been provided for by the universal appointment of Medical Officers of Health, but otherwise the catalogue of matters to be accomplished remains in the same state as seventeen years ago.—E. H.]

III. The Joint Committee expressed their belief that abundant Evidence could be adduced to show:—

Defective and Incoherent Legislation and Administration.

—(1) that the Laws and Regulations which relate to the appointment and action of medical men in the Statistical, Medico-legal, Supervisory, and Sanitary departments of the Public Service, are for the most part defective, complicated, and incoherent,—that they differ considerably in different places and parts of the kingdom,—that they are often inefficient and fallacious in operation, and sometimes even found to be subversive of their professed objects;—

No special qualification for officers.

—(2) that there is no sufficient guarantee for the general competency or the special qualifications of the medical men appointed;—
no recognized plan of Education for Officers of Health and Medical Jurists, nor any Examining body for directing the standard of their acquirements and for testing them;—

Impediments to free exercise of opinion and function.

—(3) that these appointments are made without any proper conditions to secure the free, unbiassed and unfettered exercise of judgment, delivery of opinion, and discharge of duty;

Ill-defined districts and conflicting jurisdictions.

—(4) that the districts and areas of jurisdiction in which sanitary and other public medical duties are now performed, are not defined or settled on any sound or rational principle,—
that, except in the metropolis, they are rarely conterminous with other districts for local administration or record;—
and that they are not used for the performance of the same functions in all parts of the kingdom;—

Entire neglect of the majority of the population.

—(5) that the greater portion of the population is now excluded from the benefits which might result even from the present imperfect system of appointments;—

Want of authorised co-operation of officers.

—(6) that there is a total absence of and a great necessity for some authorised co-operation between the several medical persons officially employed in different public duties, within the same district;—

Necessity for organization and consolidation of duties.

—(7) that many sanitary enactments, protective regulations and medico-legal investigations, are imperfectly carried into effect, owing to the want of a scientific staff of Officers, appointed to act in districts of extent sufficient to engage the whole of their time and attention;—and

—(8) that, consequently, an improved organization of districts, and a consolidation of public medical duties therein, are indispensable to the Efficiency and Economy of Local Administration.

April, 1868.

APPENDIX C. (See Page 324.)

Memorial of the Joint Committee on State Medicine of the British Medical and Social Science Associations, dated 10th June, 1877.

TO THE RIGHT HONOURABLE THE EARL OF BEACONSFIELD.—The Memorial of the Joint Committee on State Medicine of the British Medical and Social Science Associations

Humbly showeth:—

That your memorialists in 1868, asked for the appointment of a Royal Commission of enquiry into the operation and administration of the Sanitary Laws, under the conviction that the laws then in force were to a great extent inoperative, owing to opposition or indifference on the part of local authorities, to clashings of jurisdiction within the same areas, to the want of sufficient power in the hands of the central authority to enforce compliance with their enactments, to the difficulty of administering the laws, and to the ambiguous and often contradictory character of the laws themselves.

The Royal Sanitary Commission collected much valuable evidence, and reported that the duties of sanitary authorities were "seldom discharged," and recommended a consolidation of the law relating to public health, and other changes in sanitary administration, several of which have been adopted and made law by the Public Health Act, 1875.

That your memorialists in May, 1876, convened a Sanitary Conference of representatives of local governing bodies, and others interested in public health, under the presidency of Lord Aberdare, to consider how, in any change of the existing system, greater efficiency of action, more complete representation, uniformity of powers of local authorities, simplicity of laws and economy of expenditure could best be obtained. The result of that Conference is the memorial we have now the honour to present to your Lordship.

[*Unification of the Sanitary Law for "Urban" and "Rural" Districts.*]

[1] Your memorialists believe in the urgent necessity of some further action on the part of the Legislature in order to protect the public health, and which they are persuaded can be largely advanced by so far re-modelling the laws relating to government as to remove the distinctions which now exist in thr powers and obligations vested in urban and rural sanitary authorities. These distinctions create many difficulties and much confusion in local administration, and it is notorious that many portions of rural districts are more strictly urban, both in character and population, than many outlying portions of urban districts, or even the districts themselves.

The law which regulates streets and buildings is now mainly under the control of urban authorities, and any differences in the condition of rural districts in these respects, as contra-distinguished from cities and towns,

could easily be met by the passing of bye-laws, always capable of being altered and amended to meet the existing conditions of the district.

The breaking down of this distinction between urban and rural sanitary districts would secure simplicity in the law, and attain an object long and earnestly sought for by your memorialists—uniformity of public health enactments for every part of the kingdom.

[*Establishment of County Boards.*]

[2] Your memorialists have been very strongly impressed with the need of economy in carrying out sanitary improvements, and generally in the administration of the functions of local government; and they believe that a reconstruction of sanitary agency such as is hereinafter recommended, is consistent not only with complete efficiency, but with the accomplishment of a much larger amount of work done at a less cost than at present. This can readily be obtained by constituting, instead of the many local authorities under various names now existing, one elected and representative body, clothed with all executive functions, whether municipal or sanitary, with the area of its jurisdiction.

There are, however, duties and obligations which cannot be exercised altogether satisfactorily within a limited area, whether of a borough or a local board district, so as to secure the greatest amount of benefit with the smallest necessary outlay. Many works can only be adequately carried out by the combination of districts, with a money contribution spread over the whole area, to be levied in a ratio proportional to the benefit to be conferred. Lunatic asylums, workhouses, bridges and the like, come within this category; and there are many difficulties in the present system, with respect to water-supply, drainage, sewerage, and the disposal of sewage, which would be reduced to a minimum were such a combination as is here proposed provided for by law, and not left, as at present, to the almost impossible agreement of the constituting and contributory authorities. There are other and most important functions, which would be fulfilled by a representative body of a high order, such as the constitution of a board of appeal between district and district, within the area of its jurisdiction, or between ratepayers, inhabitants, and authorities, to authorise and require to be executed, and, if necessary, to execute works when authorities are in default and their districts suffering from the neglect of the duties and responsibilities with which they are clothed, or where joint works are desired, and specially to control water-shed areas, and to regulate such matters as relate, both in finance and use, to a county, rather than to a sanitary district. An almost universal consensus of opinion has been arrived at that the establishment of a County Board for purposes alike and akin to those here indicated is an essential element in any scheme for ensuring local and sanitary progress.

[*Re-arrangement of Boundaries of Districts.*]

[3] Some inquiry is necessary to re-arrange the boundaries of districts, but your memorialists believe that existing areas should be as little interfered with as is consistent with the public service; although this re-arrangement becomes of less importance when an authority shall be provided, clothed with sufficient powers to regulate or remove anomalies arising from peculiarities in the position or constitution of districts, and to act as an intermediate body between the representatives of district and central government.

[*Remodelling of the Public Health Medical Service.*]

[4] Thus also an opportunity would be furnished for entirely remodelling in the national interest the public health medical service. By establishing a

County Board for administration and finance, it would be possible to secure the services of health officers of high scientific attainments and of acknowledged ability; paid adequate salaries for superintending the whole or a division of a county; acting as consultants under the direction of a chief attached to the central authority; affording counsel and assistance to district officers in all cases of doubt or difficulty arising in the discharge of their duties; examining and acting on the weekly returns of disease and deaths furnished by district registrars; and also aiding courts of justice by acting as experts in all cases of criminal jurisprudence requiring medical evidence as to injuries causing or tending to cause death. To these county officers should be added medical officers of a district with assistants, all forming parts of a great department of the State, under the presidency of a minister of health; but all these officers should be under central control, so far as making up one great body of workers for general State medical purposes. In this, as in all other departments of local action, there should, in the opinion of your memorialists, be the minimum of interference with local government. All officers of health should be debarred from private medical practice, and be holders of diplomas in State medicine; their emoluments being secured as in the case of medical officers of the army and navy, but with a portion only of their salaries provided out of moneys voted by Parliament, the rest being paid out of local rates. It is believed that were this system in practice, the cordial co-operation of the medical profession would be secured. Without the aid of the medical attendant in giving, either directly or through the intervention of the householder, timely notice of the occurrence of zymotic disease and early intimation of death in all cases, the adoption of effective measures for preventing the spread of diseases of an infectious character becomes almost impossible.

With respect to all officials, security in the the tenure of their offices, so long as the duties attached to them are adequately and faithfully performed, would tend, in the opinion of your memorialist, greatly to the advantage of the public service.

[*Simplification of Sanitary Law and Practice.*]

Besides the maters thus generally touched upon, it is believed by those who have given the matter much and careful attention, that in many cases the law and the proceeding under it may be much simplified, and the exercise of the powers of local authorities be made more easy and effective.

[*Central interference with Local Government.*]

By far the greatest help to an improved sanitary condition of the people must be expected from the progress of general knowledge and belief in the benefits to be obtained from an ample supply of pure air and pure water, and from a more assured conviction that these essentials to a healthy life may be secured by a moderate expenditure, which in the end will prove remunerative. We believe that much may be done by the educated efforts of the governed on their own behalf, that the action of their representatives should be encouraged, not beset with difficulties, and that local government should be as little interfered with as is consistent with efficient action; but that when, unhappily, from apathy or neglect, the public welfare demands intervention of a controlling power, there should be in the law such provision as would insure the adoption of the best devised means for averting any threatened advent of disease, and for securing the permanent maintenance of the conditions of health.

Your memorialists, believing that changes in the existing law will materially

aid those charged with this administration, venture most respectfully to suggest:—

1. That the present existing distinctions between urban and rural sanitary districts should be removed, and that all sanitary authorities should be clothed with similar powers, and that these powers should be extended in order to enable them to carry out all purposes of local administration within their district.

2. That in each county, or division of a county, a representative authority of a high order should be constituted for the execution of joint works, to aid, and in case of default, to exercise control over district sanitary authorities.

W. H. MICHAEL,
A. P. STEWART, M.D., } *Hon. Secs.*

APPENDIX D.—Comparative Statements of RECEIPTS AND EXPENDITURE of Local Authorities at different periods since 1868.

[NOTE.—The figures for 1868-9 are taken from Mr. Goschen's Report of 1870; the remaining figures from Parliamentary Paper No. 209 of this Session (1885) and from the Local Taxation Returns. The expenditure of the intermediate periods (1876-7 and 1879-80) has never been isolated according to authorities; but it will not, of course, differ materially from the receipts.]

AUTHORITIES.	[From Mr. Goschen's Report.] 1868-9.		1876-7.	1879-80.	1882-3.	
	Receipts.	Expenditure.	Receipts.	Receipts.	Receipts.	Expenditure.
Poor Law Authorities	9,069,754	8,977,504	8,930,984	9,347,511	10,115,093	9,785,314
County Authorities	2,292,948	2,319,348	2,842,148	3,116,347	3,159,907	3,281,570
Municipal Corporations	2,704,768	2,976,691	4,346,776	3,510,560	3,460,345	3,275,531
Town Councils Acting as Urban Sanitary Authorities	} 4,074,732	4,040,292	} 13,928,380	13,834,951	13,077,844	13,470,186
Urban Sanitary Authorities other than Town Councils				} 4,677,014	{ 4,319,537	4,098,909
Joint Boards	.....	.....	.....		268,083	444,891
Rural Sanitary Authorities	.....	.....	368,316	498,216	546,152	516,757
Port Sanitary Authorities	.....	.....	2,398	8,473	4,842	13,498
Highway Authorities in Rural Districts	1,401,605	1,399,918	1,677,731	1,867,684	2,054,304	1,937,043
Turnpike Trustees	1,023,563	1,059,073	485,271	255,815	131,851	142,525
Burial Boards	208,586	209,365	352,775	406,504	524,050	564,916
Commissioners of Baths and Washhouses	.....	.....	.....	.....	44,885	44,813
Inspectors Under Lighting and Watching Act	82,133	79,116	44,090	36,916	24,158	24,198
Metropolitan Vestries, District Boards, &c.	1,423,557	1,469,223	1,884,017	2,296,164	1,997,003	1,919,975
Metropolitan Board of Works	2,109,330	1,935,495	2,406,965	3,445,982	3,449,751	3,152,816
Commissioners of the Police of the Metropolis	822,051	832,835	1,099,939	1,136,686	1,288,383	1,294,407
Commissioners of Sewers of the City of London	} 1,824,656	1,771,096	{ 531,480	253,673	595,132	587,144
Corporation of London			{ 1,232,605	1,091,016	1,229,338	1,241,569
School Boards	.....	.....	2,875,372	3,694,605	4,295,322	4,217,579
Commissioners of Sewers (Extra Metropolitan)	46,410	50,941	85,805	59,850	64,561	68,304
Drainage, Embankment, and Conservancy Boards	198,947	154,325	299,254	315,755	463,735	426,353
Churchwardens (Church Rate Accounts)	.....	.....	13,333	14,809	12,053	11,162
Markets and Fairs Commissioners	64,198	63,454	38,038	30,968	15,716	9,784
Bridge and Ferry Trustees	134,572	135,942	59,036	62,951	13,834	12,391
Harbour, Pier, and Dock Authorities	2,657,413	2,762,987	3,789,648	3,369,361	3,688,327	4,110,593
Totals	30,139,223	30,237,605	47,294,361	53,331,811	54,844,206	54,652,228
Less Deductions	.....	.....	571,672	589,724	1,432,151	1,774,172
Nett Totals	30,139,223	30,237,605	46,722,689	52,742,087	53,412,055	52,878,056

APPENDIX E.

AMOUNT OF OUTSTANDING LOCAL INDEBTEDNESS AT THE END OF EACH OF THE SEVEN YEARS ENDING WITH MARCH, 1883.

LOCAL AUTHORITIES.	LOCAL TAXATION YEAR.						
	1877.	1878.	1879.	1880.	1881.	1882.	1883.
	£	£	£	£	£	£	£
Poor Law Authorities	3,893,771	4,260,767	4,653,617	4,975,980	5,271,303	5,560,720	5,842,012
County Authorities	2,981,999	3,012,117	2,963,014	2,924,915	2,995,311	3,112,185	3,235,655
Municipal Corporations	6,221,037	6,421,082	6,313,217	6,172,887	6,495,112	6,836,034	6,936,941
Town Councils acting as Urb. San. Auth.	41,539,549	46,183,928	46,666,978	50,325,471	53,213,834	55,558,329	59,791,800
Urb. San. Auth. other than Town Coun.			10,067,472	11,354,152	12,818,333	13,600,728	12,587,129
Rural Sanitary Authorities	330,313	451,680	642,617	848,198	1,081,056	1,218,218	1,352,941
Highway Authorities in Rural Districts	47,536	49,754	49,190	49,580	47,584	42,860	45,062
Turnpike Trustees	1,283,017	1,009,998	713,164	550,237	420,294	342,458	249,537
Burial Boards	1,238,874	1,589,852	1,664,829	1,682,009	1,717,612	1,835,385	2,179,385
Metropolitan Vestries, Dist. Boards, &c.	1,708,113	1,901,220	1,936,723	2,140,496	2,145,526	2,147,143	2,057,148
Metropolitan Board of Works	11,257,190	11,898,706	13,126,259	14,645,816	15,245,229	16,669,641	17,520,679
Com. of Sewers of the City of London	356,775	346,775	336,775	276,053	265,951	458,809	693,881
Corporation of London	5,531,000	5,376,000	5,256,000	5,129,800	5,274,800	5,470,150	5,121,100
School Boards	5,456,361	7,188,900	8,685,093	9,937,152	10,858,988	11,841,142	12,818,861
Harbour, Pier, and Dock Authorities	22,214,124	22,734,436	23,165,561	23,950,405	24,396,722	24,815,675	25,945,768
Miscellaneous Authorities	1,985,806	1,987,678	1,949,080	1,970,919	1,955,644	2,195,163	2,765,027
TOTALS £	106,045,465	114,412,201	128,189,589	136,934,070	144,203,299	151,704,640	159,142,926
Population	24,460,000	24,760,000	25,010,000	25,323,000	25,974,439	26,055,406	26,406,820
Valuation to Poor Rates:	£	£	£	£	£	£	£
Gross Estimated Rental	146,989,979	150,980,679	154,606,467	157,968,723	160,248,997	165,143,300	167,449,369
Rateable Value	124,587,474	127,948,380	131,021,019	133,769,875	135,645,473	139,636,307	141,407,686

"PREVENTION IS BETTER THAN CURE."

ADDRESS TO THE WORKING CLASSES,

BY

CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

THE Sanitary Institute has made it one of its duties to provide an address to the working-classes of the town in which it holds its Annual Congress. And it has been allotted to me, as Chairman of the Council of the Sanitary Institute, to address you on this occasion.

If it were necessary to assume a title for my address I would select the motto of a kindred society, viz., the National Health Society, which is, "Prevention is better than Cure." For we sanitarians hold that the health of a nation depends very much upon the will of the nation. More than one-half the diseases from which we suffer, and more than one-half the deaths, arise from causes which we sanitarians say are within our own control.

The present is an occasion of more than usual importance, for not only does the near approach to our shores of a dire epidemic, the cholera, compel us to direct our attention to the progress of sanitation in this country, but Parliament and the public have at last awakened to the fact that a large portion of the working classes of this country have been, and still are, permitted to live in wretched unhealthy dwellings, and an Act of Parliament has been passed for amending the law relating to the housing of the working classes.

These two subjects are closely related to each other.

There are many people who assert that we have made so much progress since the last visitation of cholera to this country that we may now hope almost entirely to escape from its ravages. I earnestly wish I could believe that it might be so; but when I

endeavour to take stock of our sanitary progress, I see that whilst much, very much, has been done, yet much, very much, remains to be done. The sanitary motto is, "Nil actum reputans dum quid superesset agendum"; which may be translated, "Do not stop to congratulate yourselves on how well you are getting on before your work is even half done."

I do not think that, so far as cholera is concerned, much has been learned in late years which previous epidemics had not taught us.

No doubt there have been many theories. It was asserted by the eminent German physiologist, Dr. Koch, that cholera is caused by the presence of a minute organism or microscopic creature present in the blood of the sufferer.

When this theory was first put forward, many persons were prepared at once to accept the theory, because it accorded with discoveries made in recent years that certain diseases, especially in animals, have been traced to the presence in the blood of minute creatures, visible only by the strongest microscopes, and that these microscopic creatures are under certain conditions present in air or water in quantities innumerable in the form of germs, that is to say, spores or seeds, or eggs.

When these germs are drawn into the body of a man or animal, either by breathing, or eating, or drinking, or otherwise, they thence pass into the tissues or the blood, and are hatched into creatures called microbes, or bacilli, or micrococci.

The theory put forward by Dr. Koch to account for the cause of cholera has, however, not yet been established; but notwithstanding, I think it may interest you to give you a short sketch of the work upon which some of these minute creatures are employed, because this knowledge throws an important light upon the processes which cause what we call the decay of matter, by which we are constantly surrounded. It is owing to this decay of matter that many sanitary difficulties arise, especially where large numbers of people are crowded on to a small area; and a knowledge of the conditions which govern the processes of decay, is essential to enable us so to direct them, that instead of being a source of injury, they may be made beneficial to the community.

The existence of these minute creatures was first discovered in connection with the fermentation of beer. One important species are the active workers who by their proceedings produce what we call fermentation in beer or wine. They convert into alcohol the sugar which is present in the malt or in the grapes or other fruit. What we call putrefaction is the work of other similar creatures. Others, again, appear to be the agents in some forms of disease.

If on a bright day the shutters of a room be closed, and a single ray of sunshine be allowed to penetrate, the ray will reveal the presence in the air of moving particles of fine dust. Dr. Tyndall has shown us that there are ever present in this dust many germs of certain low forms of life, which are always ready to become alive and assume activity whenever they fall on substances favourable to their development. Although these creatures, as we may call them, are only to be seen through a very powerful microscope, they are of the greatest importance in nature.

Whenever and wherever there is going on a decomposition of organic matter, or what we call putrefaction, whether it be the case of an herb or an oak, of a worm or a whale, the work is exclusively done by these infinitely small organisms.

You may have heard that in Constantinople and other eastern towns all the refuse matter from houses is thrown into the streets, and that a number of dogs who are homeless live entirely in the streets, and by feeding on this refuse matter perform the part of scavengers. To compare small things with great we may say that these microscopic creatures are nature's scavengers. They are the important, almost the only, agents of universal hygiene. They clear away, more quickly than the dogs of Constantinople, or the wild beasts of the desert, the remains of all that has had life. They, therefore, protect the living against the dead. If dead matter were not thus cleared away, there would be no room left by this time on the earth for the living; and if there are still living beings, if, since the hundreds of centuries during which the world has been inhabited, life continues to be equally easy and plentiful, it is to them that we owe it.

Let me explain this a little further. Animals or vegetables, whilst they are in the condition which we call alive, are continually employed in working up into the solid matter of which their bodies are composed, gases taken from the atmosphere, or nitrogenous and saline substances which are dissolved in water. For instance, if you take some seeds of mustard and cress, and put them on a piece of flannel in a plate with water, and place the plate in the sunlight near your window, you will soon have a luxuriant crop of mustard and cress, derived from a combination of the salts dissolved in the water and the gases in the air, assisted by the sunlight. Thus it is possible, by means of air, and the gaseous elements it contains, by means of water, and the elements contained in rain, to create and develop the smallest blade of grass as well as the largest oak whose mass exceeds by many hundred times that which originally existed, ready made, in the portion of earth in which it took root.

An oak, a blade of grass, an animal that lives by eating grass, as for instance a sheep, or a carnivorous animal that lives by eating the sheep, as for instance a lion, or indeed each one of you here present, were all originally water, carbonic acid, salts of ammonia, and soluble mineral substances. But when once these substances have been converted into the oak or the blade of grass, or into the sheep, or the lion, or the man, that is to say, into organic matter which can be handled, and which is insoluble in water, this new matter is as it were paralysed, and incapable of contributing to the nourishment of a new vegetable life; and if it were to remain perpetually in this state, if its elements were never to pass back into the atmosphere, or into the water which circulates around the globe, the atmosphere would soon be deprived of the elements it contains, out of which organisms are produced; water would be deprived of its nutritious matter, and life would become impossible on the surface of the globe.

It is these minute microscopic beings, who we are barely beginning to know, but who have always existed side by side with us in the larger world of animals and plants with which we have always been familiar, who have been the workers, who, at the moment when life has ceased in a plant or an animal, begin to redistribute its component parts back into the air and the water, and thus make it possible for fresh generations to succeed each other, inheriting not only the form, but the matter of previous generations. They are very small, you will say, for such a duty. Their infinite smallness is balanced by their prodigious activity. Their function is to destroy organic matter. But the larger animals also destroy organic matter, for their food, with this difference: a man consumes daily a quantity of food equal to one-fiftieth part ($\frac{1}{50}$) of his weight. One of these microscopic creatures will remove in one day from 50 to 100 times, and even more, its own weight of the organic substances which it is occupied in breaking up. In addition to this their number is enormous, and the rapidity with which these low forms of life increase is marvellous. It has been calculated in the case of one or two forms grown under favourable conditions that every individual produces 8,388,408 other individuals in twenty-four hours.

But there is another side to the part played in nature by some of these minute beings. It has been undoubtedly proved that certain diseases in plants, animals, and men, arise from one or other species of these minute creatures when present in the plant, or in the blood, or in the tissues of animals suffering from disease.

For instance, the disease from which silkworms long suffered

in France is one; the disease called anthrax in sheep is another; also pig plague, splenic fever in cattle, and fowl cholera.

It has been ascertained that blood or fluids containing these minute creatures or their spores or seeds transmit the disease when inoculated into other animals; but that when these minute beings or their spores are absent, or artificially separated, from the blood or fluids inoculation gives no such result. It has also been proved that these minute beings taken from the blood of a diseased animal can be cultivated in gelatine or other substances, and after ten or fifteen generations the gelatine or fluid which contains the creatures which are the descendants resulting from these successive crops can, if then inoculated into a healthy animal, reproduce the original disease. And what is still more remarkable is that the methods employed in the cultivation can modify or increase at will the virulence of the communicated disease.

These minute beings work at the destruction of dead matter, and cause the disappearance of organisms which life has forsaken; others take possession of living organisms, sometimes producing rapid death, sometimes only local disorders; or, when they are not strong enough to fight and conquer, they lie in wait till some external circumstance, a loss of blood, or a chill, shall weaken the animal in which they are implanted, and shall make their prey easier to seize.

In this double part of theirs, when they are working for us in clearing away dead matter, or when they are working against us in producing what we call disease, they display the same double characteristic of infinite smallness in apparent means and of powerful destructive energy in results. The study of these creatures, of their habits, and of the methods by which they can be increased or destroyed is, therefore, as it were, a study of the laws of health and disease; for if the various theories which are being now deeply studied both in England and abroad should prove to be all correct, and if the laws which govern the propagation or destruction of these minute beings were fully ascertained, on the one hand the sanitarian would learn how to get rid of refuse matter easily and effectually in a manner beneficial to the community; whilst on the other hand the art of the physician would be raised from dependence on empirical observation into the position of an exact science.

When we consider the marvellous facility of reproduction, which these creatures possess, we are lost in astonishment that any higher form of life can exist subject to the possibility of invasion by such countless hosts of occult enemies.

The spores, or seeds or eggs, of these minute creatures are incessantly spreading in abundance through the air. But there

they meet with causes of destruction or stagnation. Some are dried up; others are destroyed by the oxygen of the air, or by the heat, and the light of sunshine; whilst cold slackens or puts an entire stop to their energy. No doubt they do not all perish, and those endued with greater powers of resistance survive; but fewer germs are found in the air on hills than in plains, in a frozen desert than in fertile soil, away in the country than near dwellings, in private houses than in the crowded dormitories of barracks, schools or workhouses, in an empty cellar, where the ground is dry and the air calm, than in a damp, windy yard.

You will thus see that even if the views of those who are prepared to accept the germ theory of disease to its fullest extent were shown to be true, we have it in our power on the one hand to promote to some extent the destruction of these germs; whilst on the other hand it seems to be certain that unless the germs fall on congenial soil they seldom fructify into disease.

And as we pursue the subject further, we find that the science of the prevention of disease, that is to say, the science of hygiene, advances quite as rapidly as our knowledge of the causes of disease.

Indeed, these inquiries bring us round to the same conclusion at which sanitarians arrived before these new theories of disease were developed.

Moses laid down strict rules of cleanliness for the Israelites in the desert, and there has not been to this day a better sanitary teacher than Moses. Ever since his time it has been established that when epidemics of disease have prevailed, those localities suffered most in which dirt was accumulated in and around the houses, where the ground was saturated with foul matter, where people were crowded together, and where the water they drank was impure or stagnant.

It is through the faith which this teaching has given us in the certainty that if we keep our towns, our houses, and our persons clean in the true sense of the word, if we allow of no pollution around us of air or water, we need not dread the cholera which is approaching.

We may learn from the past history of cholera, both in this and in other countries, what we have to expect on this occasion if it should visit us.

Let me tell you the facts as to what is the experience of India. Cholera is never absent from the low-lying district at the mouth of the Ganges, in India; and in that district the population, numbered by millions, live in wretched hovels, crowded into large villages, surrounded by a luxuriant jungle. The soil is a rich

and fertile black loam. It is scarcely above the level of the water in the streams which meander through it, and consequently the soil is always water-logged. The water the people drink is taken from stagnant fœtid pools. The atmosphere is saturated with moisture.

When the country is flooded there is no cholera. Cholera appears with the drying up of the surface.

In certain years, but why we know not, the cholera spreads out of this district. The course of cholera over India has no relation to roads, railroads, or movements of the population. It moves out from the Delta, sometimes towards the north-west, sometimes towards the south-west, or sometimes into Assam in the north-east. In India it never reverses the direction in which it is proceeding. Its course is determined by season, and by topography. It increases in the dry months, and decreases with the advent of rain. It does not spread from point to point of an area. It falls like a series of rain-showers, and this only on a few places. Thus, out of 480,549 towns and villages, all the deaths in 1882 were furnished by 47,648, or less than a tenth, scattered over the whole area of India.

Thus the cholera exercises discrimination in its attacks. It will visit one town or village, and leave many others in the vicinity untouched. Similarly it will attack one house and leave another. But it has been generally found that the attacked house or village held out a special invitation from its insanitary condition.

In Europe the great epidemic of cholera took place in 1832, when it seems that 16,437 persons died in England and Wales. In 1849 another cholera epidemic visited this country, when the deaths numbered 53,293. In 1854 there was again an epidemic but of a less severe character; the deaths numbered above 20,000; and again in 1866 there were 14,378 deaths from cholera in England and Wales, and during at least 13 out of the last 20 years cholera has been present in one or other part of Europe.

Whenever cholera has taken an epidemic form in Europe it has invariably followed the same law as in India, and has selected for its temporary halting places those localities which offer to it the best inducements to visit them.

The Royal Commission who reported upon the very severe visitation of cholera which occured in 1849, say that the experience of that and former outbreaks showed that the same houses or the same localities have often been revisited in recurring epidemics; but that where material improvements have been made in the condition of the dwellings of the labouring classes there has been an entire exemption from the

disease, and that where minor improvements have been introduced the attacks have been less severe and less extensive, and the mortality comparatively slight. Let me give you some instances of what I mean. At Malta it was found that the same localities and houses which had yielded the majority of plague deaths there in 1813, yielded the majority of the deaths in the cholera epidemics of 1839 and 1867; and that during the intervals of those years the same localities had yielded the majority of cases of small-pox, fever, and of anthrax, a very special eruptive epidemic attended by carbuncles. Also, it is noteworthy that in 1848 the first case of cholera that occurred in the town of Leith took place in the same house and within a few feet of the very spot from whence the previous epidemic of 1832 commenced its course. On its re-appearance in 1848 in the town of Pollockshaws it snatched its first victim from the same room and the very bed in which it broke out in 1832. Its first appearance in Bermondsey in 1848 was close to the same ditch in which the earliest fatal cases occurred in 1832.

Indeed, so long as the insanitary conditions remain epidemics invariably haunt the same localities. A few scattered drops of the storm may fall elsewhere, but the violence of an epidemic is spent where its purifying influence is most required.

Thus you will see that the experience of Europe entirely corroborates the experience which has been acquired in India.

Cholera travels slowly; it stops where it finds filth, decaying refuse, a crowded dirty population, bad water, damp polluted subsoil, or any other of those conditions which lead to bad health in a population, and which, when cholera is absent, afford an evidence of their existence by the prevalence of scarlet fever, small-pox, typhoid and other fevers, measles, whooping-cough, &c.

You have read no doubt in the newspapers of how largely the Spanish nation has suffered from cholera. In that country the deaths from this disease have numbered nearly 100,000 in the present year; and you have heard how severely that disease affected the town of Marseilles last year, and has again visited it this year.

The severe visitation in Spain is the result of the dirty condition of Spanish towns, and the use of water drawn from wells into which the matter from the cesspits percolates.

In Marseilles the following description will give you some idea of the state of the town.

It is the account of his visit to the town in the month of August last sent by a correspondent to the French *Journal d'Hygiène*.

It is as follows:—"Yesterday I wandered about one of the

suburban quarters of Marseilles. In vain I sought for a paved or macadamised street. The inhabitants dig out of the soft earth of which the streets are formed small winding uneven channels to receive the foul water from their kitchens and washhouses. In the more level parts of these channels the solid refuse matter accumulates and causes small pools filled with foul stagnant putrefying liquid. When the accumulation of liquid becomes troublesome, a neighbour makes a passage for the water by clearing out the black mud with his spade and throwing it on to the road, where it is left to dry up and exhale fœtid vapours in the hot sun."

More than a hundred streets, containing 60,000 inhabitants, are in this condition, and these streets abut on the old port, the surface of the water of which is covered with a thick coating of stinking liquid. On the east side of the old port is a collection of houses containing 700 persons, where the discharge from the privies all falls into the courtyard round which the houses are built, and forms a mass of night soil, in some cases two or three yards thick. Such is the condition of the town this year after the terrible warning which the inhabitants received in the fearful cholera visitation last year.

This shows you what a pressing invitation Marseilles sent to beg the cholera kindly to visit it in its journey west.

It has been assumed in most European countries that cholera is the most infectious of all diseases. Experience shows that it is one of the least infectious.

If the money which is now spent on useless quarantines in Italy and France, and on other measures which are a curse to mankind in general, and especially to the countries where they are carried out, were spent on sanitary improvements, there would be some solid benefit to show for it.

You will thus see that whilst we are unable either to account for the cause or to prevent the periodic recurrence of epidemic diseases, the sanitarian has learned that it is possible to mitigate the severity of the visit.

The latest conclusions of Indian experience tell us that sanitary improvements, and sanitary improvements alone, embrace the whole action which a Government can take in order to prevent cholera. Pure air, pure water, pure soil, good and sufficient food, proper clothing, and suitable healthy employment for both mind and body, these are the great requisites for resisting the cause or combination of causes which produce cholera. The avoidance of overcrowding is just as important as the provision of pure water; good drainage, and good conservancy are essential—just as it is essential that the people should be well housed.

In fact, we may sum it up that from whatever cause the disease arises, pure air and pure water afford almost absolute safeguards against cholera, as indeed they do against most forms of zymotic disease.

We cannot feel certain that we shall escape from the present visitation of cholera to Europe, for in previous visitations it has first commenced in September or October, assuming its maximum virulence in the following summer. But if, on this occasion of its visiting Europe, we do suffer from the disease, it will be because we fully deserve to suffer for our neglect.

If cholera does visit our shores—if it should visit this city—do not fear its spread by personal infection; but look well after epidemic localities, and get the people out of them. A very short distance will often separate a deadly spot from a safe one.

Cholera begins with diarrhœa. For treatment, you should establish house-to-house visitors to look after premonitory diarrhœa; and one of the most essential provisions is to have some place for treating cases as close as possible to the attacked house. Removal of a collapsed or recovering case to a distance means death, and the best thing to do, whenever it can be done, is to remove the unattacked persons out of the house, and to keep the patient at home. The house to be thoroughly cleansed, aired, and lime-washed before being again occupied.

One of the special objects of epidemics seems to be to arouse mankind, by signs which cannot be mistaken, to a sense of the necessity of recognising and obeying the laws of his physical existence. The health, the well-being, and the duration of the life of man are intimately connected with the observance of the natural laws of the universe in which he dwells. The knowledge of this fact has unfortunately not been sufficient to insure obedience to those laws. Periodical epidemics are therefore necessary, in order that men may be taught individually and collectively to obey these laws: for it is only by obedience to the laws of nature that we can insure the possession of that immunity from disease which the great Creator obviously intended His creatures to possess.

There is a free choice given. On the one hand there is obedience and health, with all the numberless blessings and privileges which go with it; on the other there is neglect and its infallible consequences, which no human power can fully avert when they are entailed, and these are disease, death, pauperism, loss of property, ignorance, debasement, crime.

We have too long neglected these matters. We have neglected them in our Parliament, in our municipalities, and in our houses—and more especially have we neglected to educate our children in a knowledge of the laws of health.

The social evils of this neglect are at present ramified throughout the entire framework of society. A vast amount of property has grown up in all parts of the country, of which it is not too much to assert that it is as productive of misery to the people, as it is unproductive of legitimate revenue to the possessor. Large masses of population have been allowed to congregate together without sufficient attention being paid to those conditions on which their healthy existence depends.

It is only in recent years that the community has become awakened to the fact that if a large population is to be allowed to crowd itself into a town, it can only do so safely with a due regard to its health by observing strict sanitary regulations.

If you live in a town you must conform to regulations in the laying out of streets, in the building of houses; you must bring in pure water from a distant source; you must carry off fouled water by drains, and not simply turn it into your rivers, so as to convert pure streams into dangerous nuisances. If all this had been recognised and acted upon during the last 80 years, what a large amount of sickness, what a number of premature deaths, would have been avoided!

We must remember that we have for years, nay, centuries, neglected these matters; and that if we now find that they are expensive to carry out, we are merely paying for this neglect of our forefathers or of ourselves.

The fact is, the whole question of sanitation brings us to that of the housing of the people.

It is for that reason that I have always held that the question which is of far the highest importance amongst the social questions of the day is that of the manner in which the working classes are housed; and I maintain now, after forty years of watching the devolopment of this question, that the root of all real progress in a nation lies in the condition of the dwellings.

Upon this question hinges the morality, the education, the religion, the health, and the happiness of the nation.

How can a population be moral if men and women, girls and boys, are crowded together in one room, and often in one bed? Of what profit can the schools, the churches, and the chapels be to a population which lives in houses where decency or privacy are impossible? How can health be maintained in houses where the water supply is defective, where the means for removing the refuse are neglected, where the overcrowding vitiates the air?

You have long ago passed laws to prevent the adulteration of food. But it is only the other day that Parliaments enunciated the very mild doctrine that no one has a right to let a house which is not in all respects reasonably fit for human habitation.

Nearly 50 years have elapsed since this question of the housing of the working classes was brought into prominence by the leaders of sanitary improvement, and great blame attaches to those in whose hands the government of the nation has rested during those years, of whatever party they may be, for their long-continued neglect of this question.

Dr. Farr, who died two years ago, after attaining to the position of being the leading sanitary statistician of this age, devoted the best years of his life to tracing out the facts which relate to disease in connection with its surroundings. He showed that in proportion as you have a population concentrated on a small area, so will the mortality of that population be increased. That is to say, supposing you have a thousand families living in cottages, in country districts, a certain number will be ill and a certain number will die every year; whereas if those thousand families, instead of each having its cottage and garden with fresh air round it, live close together in a town where often several families are crowded into one house, where streets are narrow, a much larger number out of the thousand will be constantly ill, and a larger number will die.

It has also been shown that the grandchildren of people who live in towns, and who grow up to become adults, are only half as numerous as those of labourers who live in healthy country districts.

You will say that Leicester has increased by 27,000 persons between 1871 and 1881, and many other towns have increased as fast, if not faster; but the great increases in town populations depend upon the people who come in from the country districts; and although, as I will presently explain to you, sanitary science shows that the inferior health of town populations can be much modified, yet the town population starts with a disadvantage as to the health of the inhabitants. Now I want to impress upon you that it is possible to a great extent to diminish this disadvantage by improving the surroundings of a town population, by making the dwellings airy, by not building them too close together, by so placing them on the ground that air and sunshine may penetrate between them, by removing daily all refuse from the houses, the yards and the streets; and by thus diminishing the adverse influences which the crowding together of people in towns exercises on health.

There is much experience on this matter. In London the most densely peopled areas used to be the most unhealthy, but by adopting a new form of building, densely peopled areas have become very healthy, although the number of people on each acre was increased. For instance, in the old buildings in which 67 families lived on an acre of ground, the death-rate was 24·16

per 1,000. In the model blocks of artizans' dwellings, where there are from 140 to 180 families congregated on one acre, and where the conditions I have just mentioned have been carefully attended to, the death-rate has been only from 16 to 18 per 1,000. The reason of this is obvious. The old system was to cover the ground with houses of one, or at most two storeys high, placed close together in narrow streets, whereby there was no space left for the circulation of air between and around the houses. These new model dwellings in town districts, where the surface of the ground is so valuable, are built in blocks of several storeys; the blocks of buildings should be placed with their axes lying north and south, so that the sun may shine on each side during part of the day; five or six houses thus placed as it were one above the other, and in that way you can reserve plenty of space at the back, and at the front of the houses so as to allow ample circulation of air all round and through them, whilst at the same time a large number of families can be accommodated in them. In these houses, moreover, there is a porter who sees that the ground surface all round is kept scrupulously clean, that no refuse is allowed to remain in or near the houses. He is always at hand to see to small repairs, so that things are not allowed to get out of repair for want of "*the stitch in time.*"

Let me tell you briefly what are the principal matters which should be attended to when you build a house, so as to make it healthy. You must start with the condition that it must be surrounded with pure air to breathe, and be supplied with pure water to drink. You can only have pure air to breathe, provided the surface of the ground round the house is clean, and provided the soil on which your house is built is also clean. A house must not be built upon old rubbish heaps, because the air which is drawn up by the warm atmosphere of the house from the ground will bring with it, from the slowly decaying rubbish, noxious vapours which will occasion fevers and other diseases. There must be a damp course above the ground level to prevent damp from the ground rising in the walls. The surface round must be paved to prevent dirty water from lying in stagnant pools near your house, or from soaking into the soil either under or round your house. The walls must be of clean and sound materials, and they, as well as the roof, should exclude damp. Houses should never be built back to back, but there should be windows and doors at both front and back to allow of a thorough current of air. The windows should open near the ceiling. There should be abundance of light, and no dark corners. No house can be clean that is dark; no dark room can be kept clean, for dirt

must be seen to be removed. Pure light, especially sunlight, purifies, destroys the organic poisons of spreading diseases. Observe how plants sicken and die if they have no light, but live and grow rich in the sunlight.

Dr. Richardson says, "A clean home is a pleasant home, a thrifty home, and a healthy home."

You must not keep dirty water or slops in the house, but there should be no direct communication with a drain into the house. Sink and waste pipes should empty in the open air outside over trapped gullies.

Decaying matter must not be retained in your houses. Dust-bins, &c., are a source of much danger to health, and more efficient and quicker means of removal of dust and waste from our houses ought to be adopted than that of storing it in the back yards close to the windows of the rooms. In some towns, indeed, the very objectionable plan is in force of removing the contents by taking it through the house.

I may mention that in Poplar district in London, dust-bins and ash-pits have been abolished. Each house is supplied with a zinc pail large enough to hold three days' refuse, and on known days twice in the week the dustman calls and empties these pails into a cart, which is covered so as to prevent the dust blowing about. I mention this not as a perfect mode of dust removal, but only as a great improvement on what prevails generally.

You thus see that with a proper application of sanitary principles in laying out your towns and building your houses, you may rest satisfied that there need not be any very great difference in healthiness between the town and the country dwelling, although no doubt we should all prefer free bracing country air to town air, if we could get it.

People may say that whilst it is easy to talk about improved dwellings, it is a very difficult matter to improve the houses which already exist, except gradually. I concede that. But what I want to emphasize is that for the last 40 years this question of healthy dwellings has been continually urged upon the public by sanitarians. During that interval what has happened?

The houses in England and Wales, which numbered 2,943,945 in 1841 have increased to 4,831,519 in 1881; that is to say, the houses have increased by 2,000,000.

In the last ten years there have been 5,000 new houses added to Leicester, 6,000 to Derby, 10,000 to Birmingham, besides which numbers of the houses and cottages which were enumerated in 1841 must have been reconstructed in the interval.

It has not been for the want of knowledge that this question of proper accommodation for the working classes has not advanced more rapidly. My friend Mr. Chadwick, Sir Robert Rawlinson, Dr. Sutherland, and many others now dead, explained in reports to Parliament what were the necessary sanitary measures nearly fifty years ago. Nor, in the face of the above figures, can it be said that there has not been the opportunity to improve the houses of the working classes; and if full advantage had been taken of our sanitary knowledge during these many years, in the construction of the new houses which have been built, and in the reconstruction of old houses, there would not be much now left to be done, and the sanitary and moral state of the country would be much better than it now is.

The opportunity has been neglected because neither Parliament nor the municipal authorities cared sufficiently for the sanitary wants of the community, and because the owners of house property were satisfied to accept the profits derived from letting their houses without fulfilling those duties towards their tenants which in common honesty they were bound to fulfil.

The fact that so much still requires to be done, is, therefore, the result of the supineness, neglect, and interested motives which have been governing this question for so long.

The new Act of Parliament passed last session has, no doubt, made a great step in the direction of sanitary progress. Indeed, this Act is the commencement of a new era in this question. It says that "in any contract made after the passing of this Act, for letting for habitation by persons of the working classes a house or part of a house, there shall be implied a condition that the house is at the commencement of the holding in all respects reasonably fit for human habitation."

The bill, as originally presented to Parliament, went further. It stated explicitly what we sanitarians desire should be the effect of the clauses. It said, that "in the event of a breach of any such condition as above-mentioned in the case either of a furnished or unfurnished house, any inmate of such house who suffers any loss by injury to health or otherwise in consequence of such breach, shall be entitled to recover damages from the person responsible for such breach." These words were omitted from the Act; but the omission would not necessarily prevent a court of law from giving effect to the intention.

Let me explain to you what that intention was. If a house were let to you in an insanitary condition, the landlord would be responsible for the injury which such insanitary condition entailed upon the tenant. For instance, if the house in which you live has been built on a rubbish heap, and fever and sickness prevail in

your family, and your landlord did not warn you when you took the house as to what was under it, he ought to compensate you for the disease from which you suffer. And if, when you pour away the dirty water down the sink the pipe which conveys it away leads straight into the sewer and brings you back sewer gas in exchange, and if disease results to yourself or your family, the person who owns and has let you the house should compensate you for the injury he has done to you by letting to you an unhealthy house which contains such insanitary conditions. Or, again, if your roof is in bad repair and lets in water, and you consequently get rheumatism, your landlord should compensate you for the injury you have suffered in consequence of the defect in the roof.

I have long enunciated the view that all plans of new buildings intended for habitation in towns or villages, or detached houses, and all important alterations of existing buildings should be submitted to a local district surveyor, who should certify that the position and construction of the building would be in accordance with recognised sanitary conditions.

But I am now inclined to think that, so far as the actual construction of the house is concerned, if the provision in the new Act relating to the housing of the working classes should be held by courts of law to enable a tenant to obtain compensation from a landlord for letting him a house in an insanitary condition; that provision may operate much more effectually and much more rapidly to improve the sanitary condition of dwellings over the whole country than any regulations made by a municipal body could do; and if the provision as it now stands be not sufficient for obtaining our object, I trust that the new Parliament will take steps to make it efficient.

Owners of house property and ratepayers may no doubt be called upon to pay large sums for putting the houses into a healthy condition, but such expenditure would not have been necessary now if during past years the owners of houses had paid due attention to sanitary laws in the construction and maintenance of their houses, or if municipal bodies had exercised adequate supervision over the growth of the towns.

If now they are called on to pay large sums, the money must be looked upon as the compound interest of the money which they have saved at the expense of the diseases and the lives of the people whom they have allowed to suffer from, and to die of, preventible diseases.

It may be said that if owners of house property have to pay large sums for removing sanitary defects, they will, unless there be some counteracting influence, charge increased rents; that would probably be so.

In considering this great question we must bear in mind that these wretched and unhealthy dwellings are not only centres of disease, but they are moral cesspools, which foster misery, discontent and crime. The community, if it had done its duty in times past, would not have permitted them to come into existence, and it is for the advantage of the community that they should be abolished. It is, therefore, reasonable that, since the community has by its own long-continued neglect allowed these insanitary dwellings to come into existence, the cost of removing them and replacing them should be, in part at least, borne by the community. This has been recognised in the Act of Parliament passed last session on the Housing of the Working Classes. This Act enables urban and rural sanitary authorities to contribute out of the rates to the cost of improving the dwellings of the working classes; and if the various authorities concerned in the administration of the law do their duty in this respect in their several localities, they will take care that an adequate number of sanitary houses shall be provided for the working classes, and thus prevent the private owners of house property from unduly raising their rents.

This question has another and very important aspect. The improvement of the home means less sickness, and more energy for work. To the ratepayer it means a diminished poor-rate, whilst to the individual it means more opportunity for self-education and culture, and it opens out to every one the possibility of having a refined and comfortable home. The improvement in the standard of living and of house accommodation is only what has been going on gradually for centuries. We are told that in the 15th century, in the houses, such as they were, of the poor, the walls were of rough unhewn stone, without cement, or of mud; the roofs of thatch, or of rude straw; the windows unglazed; the floors of bare earth, without tile or boarding; the accommodation of but one room, or at the most, two, let the family have been ever so numerous; and their animal stock, where they possessed any, frequently sheltered at night under the same roof as themselves. And indeed such cottages were not uncommon 50 years ago. As a rule the working classes would be ashamed of such accommodation now.

So they will in time be ashamed of living in bad unhealthy houses. In the United States of America I have visited the dwellings of the artizans and wage classes in many manufacturing towns. I have frequently found them living in small, comfortable houses, in which each family have their parlour with appropriate furniture, pictures, and often their piano. They had come to look upon these things as a necessity. This state

of things is the result of the free education and general civilization which pervades American society.

An improved standard of living follows education, and it may be fostered by legislation; but it must come from the people themselves. Therefore do not go away with the idea that Parliament or town councils can do everything for you. They can do something. Acts of Parliament may be necessary to assist sanitary progress and to enforce sanitary discipline, but for real practical progress, we must look to our own exertions. Laws can do but little unless aided by the earnest, the strenuous co-operation of every individual member of the community.

> "How small of all that human hearts endure,
> That part which laws or kings can cause or cure!
> Still to ourselves in every place consigned,
> Our own felicity we make or find."

However dirty the locality, and however poor the house in which you live, you can yourselves do much to preserve your health.

Amongst the first necessities of health is cleanliness. You must keep your rooms clean and well-aired. This means that you must not accumulate rubbish in your houses. You must pay attention to cleanliness in your persons. You must not wear nor let your children wear dirty clothes. No doubt to men and women who have to do dirty work this is not always easy, but it is very much a matter of individual care. Look at different individuals engaged at the same occupation, and how clean one often is compared with others. The difference between cleanliness and uncleanliness is very much a question of habit.

Clothing should be not only washed and brushed, but when removed from the body at night it should be turned inside out and suspended in the air. You should wash yourself and well rub yourself or scrub yourself all over every day with a brush. All the vital functions of the body are benefited by this one simple act. This habit of daily ablution should be taught to the young from their earliest life. It then becomes a habit—a second nature. Expensive appliances are not required for cleansing the surface of the body. A wash-hand basin, a shallow tub to stand in, a lump of soap, a large clean towel, and a gallon of pure water are all that can be wanted for daily ablution. Indeed, a quart of water, with the aid of a soaped brush to scrub yourself with, could be made to suffice. There are few so poor who cannot afford these few things, and the experiment always pays in the increased health, happiness, and vigour which it brings.

Mr. Chadwick, who is the leader of all sanitary progress in this country, and who is now about eighty years old, showed that in an orphan asylum the death-rate (which may be taken as an evidence of the degrees of health) was greatly reduced after the practice was adopted of washing the children from head to foot every day, so as to maintain cleanliness of skin. He also asserts that a well-washed child will require less food than an unwashed child, and that the food which would be required for four children who are unwashed would suffice for five children who are washed. In further corroboration of this it is known that pigs that are washed put on one-fourth more flesh from the same quantity of food than do pigs that are unwashed.

Bad health is wasted force, and is therefore actually a money loss to the community. It is very difficult to find out what is the extent of this wasted force. The death rate of a town gives us some idea of the sickness. I found, in an insanitary district in St. George's-in-the-East, that with a death rate of 31 per 1,000, the sickness rate was 270 per 1,000, or 9 cases of sickness to one death. But in the worst parts of the same district the sickness rate amounted to 620 per 1,000, which gives 20 cases of sickness to one death. And it may be generally assumed that there are on an average 20 cases of sickness to one death, of which 4 cases out of 5 are those of children.

The loss from sickness arises partly from the loss of earnings of the individual who is ill, and in the younger members of a family from the expense which the sickness causes, by loss of time and otherwise, to the other members of the family.

But if the loss by sickness is great, consider for a moment the losses to the community which are evidenced by a high death rate.

Look at the contingent losses. In the case of the cholera epidemic of 1848, it was estimated that the burden which fell on 12 of the parish unions for the maintenance during 4 years of widows, widowers, and orphans, in consequence of the deaths of relatives from cholera and diarrhœa, amounted to £121,576.

Then consider the money loss to the community from the individual deaths. To begin with, Mr. Chadwick estimates that each death involves on the average a cost of £5 in funeral expenses.

In the next place, Dr. Farr calculated that the present value of the future wages of an agricultural labourer at the age of 20 is £637. Therefore if the labourer dies at, or soon after 20, that sum is practically lost to the community. Hence every case of death from preventible diseases represents an unnecessary waste of money.

But there are many whose early death entails a far greater loss to the community than can be valued in money.

Take a professional man who has accumulated a large amount of knowledge, and what is better, of experience; or take an artisan who is a skilful craftsman. If they die in the prime of life, when they are most fitted to use these qualities, the knowledge, experience, and skill, which have required many years and much labour and expense to accumulate, all go with them, before the crop of usefulness, in the cultivation of which so much has been expended, has ripened and been gathered.

When we consider how important health is, how great should be the efforts which we ought to make to maintain it! How wicked any person is who knowingly assists in preserving those conditions in the midst of a community which allow preventible diseases, or, as some one has named them, dirt diseases, to continue.

A Jewish book, the "Mishna," says:—"Outward cleanliness is inward purity;" and, indeed, as my friend, Dr. Richardson, has so well expressed it, "cleanliness covers the whole field of sanitary labour." Cleanliness, that is purity, of air; cleanliness, that is purity, of water; cleanliness in and around the house; cleanliness of your persons; cleanliness of dress; cleanliness in food and feeding; cleanliness in work; cleanliness in the habits of the individual man or woman; cleanliness of life and conversation, morality, purity of life, temperance—these are important influences in promoting individual health; these are still more important influences in promoting individual happiness.

CLOSING GENERAL MEETING OF THE CONGRESS.

The Closing General Meeting of the Congress was held on the afternoon of Friday, September 25th, at the close of the Sectional Meetings. The President, Prof. F. de Chaumont, F.R.S., took the Chair, supported by the Mayor and other members of the Local Committee, and the Chairman and Council of the Institute.

Votes of thanks were passed to the President, the Local Committee, the Judges, and others who had been engaged in the work of the Congress and Exhibition.

The following reports upon the subjects brought forward for consideration at the Sectional Meetings were read by the Senior Secretaries of the respective Sections.

Section I.—SANITARY SCIENCE AND PREVENTIVE MEDICINE.

I have to report that the Preventive Medicine Section of the Congress has harmoniously conducted its sittings to a successful issue, under the Presidency of Dr. Arthur Ransome, and although the place of meeting was changed three times, the votaries of sanitation refused to allow their ardour to be damped, Sir Charles Cameron on one occasion coming to the rescue.

We are much indebted to the Vice-Presidents, Dr. William Collingridge, Mr. Henry Lankester, and Dr. George Shaw, as well as to the Honorary Secretaries, Dr. Moore and Dr. Johnson, for the successful arrangements. To the Readers of Papers we owe our thanks for much interesting matter.

Dr. Arthur Ransome's address on Sanitary Progress, and Dr. Buck's paper on Infantile Diarrhœa were well received, and possibly the discussion upon the latter paper may result in indicating the remedy for the heavy diarrhœa mortality of which Leicester has hitherto been the all too patient victim.

Surgeon Major Pringle's paper upon the Vaccination Question, it is to be hoped, will encourage our opponents to examine fully into this very serious question in a less biased and more dispassionate manner than has hitherto been the case, and I am quite sure that the Council of the Sanitary Institute altogether disclaim the imputa-

tion of the Editor of the *Times*, that "Because the Institute is accepting the bountiful hospitality of Leicester, therefore errors of omission and commission have been met in a too friendly spirit." It is rather that the Institute recognises that *Salus generis humani* is not to be found in crushing opposition by dictatorial assertion, but in persuading opponents by force of argument and demonstration.

Mr. Lewis Angell laid bare some impediments to sanitary progress, and Mr. F. Scott urged the extension of voluntary effort.

We are indebted to the Countess de Viesca for a paper which should encourage the management of the house upon sanitary principles, and to Mr. J. H. Buckley for an interesting sketch of ambulance work in Leicester.

The result of the second day's gathering of the Section again elicited the fact that if a special day, or part of a day, were devoted to the consideration of domestic sanitation and ambulance work, in both of which ladies take such a very great interest, it would add immensely to the success of future Congresses, and I feel it my duty to represent this to the Council of the Sanitary Institute.

JOHN F. J. SYKES.

Honorary Secretary.

SECTION II.—ENGINEERING AND ARCHITECTURE.

The observations of the President, Mr. Percival Gordon Smith, of the Local Government Board, as to the increased attention paid by the public to sanitary matters, were strikingly confirmed by the good attendance at the meeting of the Section. The allusions made by the President to the prime importance of securing efficiency in public sewage and water works, at whatever cost might be necessary, were particularly applauded. The strong recommendations of the President as to the abolition of cesspools were generally approved. A vote of thanks to him was proposed by Prof. de Chaumont, and seconded by Mr. Rogers Field, who entirely concurred in the President's opinion as to the necessity for the abolition of cesspools. The papers of Messrs. J. Underwood and J. Gordon—the first on the subject of the History of Sewage and Sewage Treatment in Leicester, and the second on the Drainage of Continental Towns—received much attention, and evoked a very animated discussion, in which Mr. Alderman Kempson, Prof. Robinson, Mr. Lemon, Mr. Peregrine Birch, Mr. Laws, Colonel Jones of Wrexham, and others, took part. Mr. Saxon Snell's paper on Circular Hospital Wards produced some discussion, but, on account of the late hour at which it was read, it was not fully considered. The opinions expressed were generally in favour of the parallelogram form of wards, and many strong objections to the circular form were raised, which remained unanswered.

The Section re-assembled this morning, and the first paper was on Smoke Abatement, which led to an interesting discussion, in which the President of the Section took part and referred to the Building Acts defining the size of chimneys. Mr. Ernest Hart, Chairman of the Council of the National Smoke Abatement Institution, Mr. J. Gordon of Leicester, Mr. Scott of Manchester, Prof. de Chaumont, and several others also took part. The effects of smoky atmosphere on health were particularly discussed. Mr. Gordon stated that the use of gas stoves in Leicester was very extensive and fast increasing since the Corporation had adopted the policy of letting stoves on hire at a nominal rent, and he pointed out that the use of gas stoves was the best means of preventing smoke from domestic chimneys. A paper by Mr. E. C. Robins, on the Ventilation of Chemical Laboratories and Science Schools generally, was read, and discussed by Mr. Rogers Field, Mr. Saxon Snell, Prof. de Chaumont, and others. An interesting branch of the discussion was upon the accuracy of Anemometers as instruments for measuring the volumes of air referred to in the paper. It was mentioned by Prof. de Chaumont that a series of experiments, to test the accuracy of anemometers, was being carried on by a Committee of the Sanitary Institute, and would be published shortly. A most important paper on Plumbing and Plumbers' Work was read by Mr. F. Scott, of Manchester, setting out the action taken by the Plumbers' Guild of London to guard the public against the evils arising from defective plumbing work. Prof. de Chaumont, Mr. Emptage, Mr. Robins, and others took part in the discussion, and the action of the Plumbers' Company was generally approved.

W. R. E. COLES,

Honorary Secretary.

Section III.—SECRETARY'S REPORT.

The President of the Section, Dr. William Marcet, read a most interesting address, dealing with the distribution and object of Carbonic Acid in nature and with its sanitary relations, and also on the influence of great altitudes on the Chemical Phenomena of Respiration, in which Dr. Marcet described some most interesting experiments which he had made upon the amounts of carbonic acid expired by persons at different altitudes, extending over a period of upwards of seven years. From these experiments Dr. Marcet adduced the fact that the body required the inhalation of a smaller weight of air, or volume of air reduced to freezing point and sea level, to produce the same weight or corresponding volume of carbonic acid as greater heights are attained.

Dr. Marcet also exhibited and explained a very interesting diagram, showing the analogy which exists in London between fogs and an excess of carbonic acid in the air of that city.

Mr. John D. Paul gave a lengthy and interesting geological lecture upon the Valley of the Soar, of considerable local and general interest, and in the discussion which followed the President of the Section, Mr. Mott, and others took part.

The Rev. T. Lawrence read a paper upon the Sanitary Evils arising from the improper burial of the dead, and in the discussion which followed cremation was advocated by Captain Douglas Galton, Prof. Symons, Mr. Boulnois, and others.

A valuable paper was then read by Mr. Charles E. Cassal, F.C.S., upon Hygienic Analysis, which was of a very interesting character, and which led to a long discussion.

In the absence of Mr. Whitaker, the Secretary of the Section read a paper entitled "A recent Legal Decision of importance in connection with water supply from wells," and the paper on "The use of Sodium Aluminate for softening and purifying hard and impure water," was taken as read, the author not being present, and the hour having arrived for closing the sectional meeting.

H. PERCY BOULNOIS, M.I.C.E.

Honorary Secretary.

REPORT OF THE JUDGES OF THE EXHIBITION, LEICESTER, 1885.

We, the undersigned, the Judges appointed by the Council, beg leave to recommend to the Council the following distribution of Medals and Special Certificates, and of Certificates of Merit.

Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals, but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks.

THE RICHARDSON MEDAL *for an* EXHIBIT SELECTED FROM THE ENTIRE EXHIBITION *will be awarded by the Judges in case of pre-eminent merit only.*

SILVER MEDALS OFFERED BY THE GAS DEPARTMENT OF THE CORPORATION OF LEICESTER.

Four SILVER MEDALS are offered by the Gas Department of the Corporation of Leicester for Gas Stoves exhibited under the following classes :—

1.—For the best Gas Stove or Gas Apparatus for Cooking purposes for families, to include means for heating a good supply of water.
2.—For the best Gas Cooking Stove suitable for an artisan's family, for at least six persons.
3.—For the best and most Economical Gas Fire.
4.—For the best arrangement for Heating Baths by Gas.

SILVER MEDALS ARE OFFERED ALSO BY THE EXETER GAS COMPANY.

1.—For the best Gas Stove or Gas Apparatus for Cooking purposes for families, including a sufficient supply of hot water.
2.—For the best and most economical Open Gas Fire.

MEDALS AND STARRED CERTIFICATES.

CLASS I.—CONSTRUCTION AND MACHINERY.

*Bradford, T., & Co., *London*, for Washing Machines.
*Doulton & Co., *London*, for Art Pottery.
Elgood Bros., *Leicester*, for Artistic Domestic Iron-Work.
Ellis, J., & Sons, *Barrow-on-Soar*, for Barrow Blue Lias Hydraulic Lime.
Leggott, W. & R., *Bradford*, for Opener for Fanlights and Skylights.
Victoria Stone Co., *London*, for Victoria Artificial Stone-Paving.

CLASS II.—SEWERAGE AND WATER SUPPLY.

Bourtreehill Coal Co., Dreghorn, *Ayrshire*, for White Enamelled Fireclay Cistern.
*Morrell's Sanitary Appliance Company, *Manchester*, for Portable Cinder-sifting Ash Closet.
*Moules' Earth Closet Company, *London*, for Moules' Earth Closet.
Sanitary and Highway Appliance Co., *Sheffield*, for Roberts's Street Orderly Bin.
Sanitary and Highway Appliance Co., *Sheffield*, for Roberts's Sand-distributor for 2-horse Tram-track.
*Trott, H., *Battersea, London*, for the "Household" Closet.
Willacy, R., *Preston*, for Sand-distributor for Roads.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

*Doulton & Co., *London*, for Ventilating Tile Stove.
*Ellison, J. E., *Leeds*, for Conical Ventilators.
*Stott, J. & Co., *London*, for Mercury Gas Governor.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

*Calvert, F. C. & Co., *Manchester*, for Carbolic Acid for Disinfecting Purposes.
*Hancock, F. C. & Co., *Dudley*, for Machines for domestic use.
Humber & Co., *Nottingham*, for their Exhibit of Bicycles and Tricycles.
Jeyes' Sanitary Compounds Co., *London*, for Jeyes' Perfect Purifier.
Johnson, W. F., *Leicester*, for Ornamental Domestic Appliances.
Lyon, J. W., *London*, for Steam Disinfector.
*Maignen, P. A., *London*, for Filtre Rapide.
Richardson, J., & Co., *Leicester*, for their Exhibit of Antiseptic Preparations.
Vipan & Headly, *London*, for their Exhibit of Dairy Appliances.

CERTIFICATES OF MERIT.

We further recommend that Certificates of Merit be awarded to the undermentioned Exhibitors:—

CLASS I.—CONSTRUCTION AND MACHINERY.

B A ADAMS, R., *London*, "Victor" Spring Hinge.
CROFT STONE QUARRY & BRICK CO., *Croft, Leicestershire*, for the Croft Artificial Stone Paving.
DOULTON & CO., *London*, Silicon Tread for Steps.
B A GREENALL, J., *Manchester*, Greenall's Steam Washer.
JOHNSON, W. F., *Leicester*, for his exhibit of Repoussé and other brass work.
KENWORTHY, E. N., & CO., *Oldham*, for Paragon Washing Machine with Canadian Washer.
B A KENWORTHY, E. N., & CO., *Oldham*, Paragon Washing Machine, and Canadian Washer.
NIGHTINGALE & CO., *Great Grimsby*, for Method of Wood Block Flooring.
B A SMITH, E., & CO., *Coalville, Leicester*, Embossed Tiles.
B A SMITH, E., & CO., *Coalville, Leicester*, Photographic Embossed and Incised Art Tiles.
STIFF, J., & SONS, *Lambeth*, for their exhibit of Architectural Terra Cotta.
WHITWICK COLLIERY CO., *Coalville, Leicester*, for their exhibit of Terra Cotta.

CLASS II.—SEWERAGE AND WATER SUPPLY.

ADAMS & CO., *York*, for Potts' Edinburgh Sewer Trap.
ADAMS & CO., *York*, for Improved Shape of Trough for Water Closets.
BOURTREEHILL COAL CO., *Dreghorn, Ayrshire*, for White Enamelled Sinks and Wash Tubs.
BROAD & CO., *Paddington*, for White Enamelled Straight and Curved Channels for Inspection Chambers to Drains.
BROAD & CO., *Paddington*, for White Enamelled Fire-clay Gullies.
DOULTON & CO., *London*, for Economical Combination Closet in two pieces.
ELLIS, J. J., *Ellistown Collieries*, for Gordon's Disconnecting Trap.
FERGUSSON & STARKEY, *Leicester*, for "Shanks's" Porcelain Lavatory Fittings.
FERGUSSON & STARKEY, *Leicester*, for Shanks's "Ureka" Spray and Plunge Bath.
FERGUSSON & STARKEY, *Leicester*, for "Unbreakable" Fire-clay Lavatory Basins for Schools, &c.
FOSTER & PEARSON, *Nottingham*, for Morris's Cast Iron Gulley, with Moveable Dip Pipe.

A Deferred by the Judges in Competition for Medals.
B Submitted by the Exhibitors for further practical trial.

GOODE & Co., *Loughborough*, for "Invicta" Flushing Cistern.
GOODE & Co., *Loughborough*, for Double Valves for Flow and Return in Hot-water Circulation.
GROOM & Co., *London*, for Well and Dry-Platform Sponge Bath.
HUMPHERSON, F., *London*, for "Beaufort" Flush-down Closet.
B A HUMPHERSON, F., *Chelsea, London*, Siphon Flushing Cistern.
JOHNSON, W. F., *Leicester*, for Galvanized Iron Dust-Bin.
KIRK, E. G., *Huddersfield*, for Night Soil Receptacle with Spring Lid.
PRINGLE, R., M.D., *Blackheath*, for Working Model of Cattle Drinking Trough.
SANITARY & HIGHWAY APPLIANCE Co., *Sheffield*, for Roberts's Asphalte Cauldron.
SMITH J., & SONS, *Wolverhampton*, for Closed Sectional Sanitary Van.
STIFF, J., & SONS, *Lambeth*, for Weaver's Ventilating Sewer Air Trap.
WORTLEY FIRE CLAY Co., *Leeds*, for White Enamelled Straight and Curved Channels, and Channel Junctions for Inspection Chambers to Drains.
WRAGG, T., & SONS, *Burton-on-Trent*, for Gordon's Junction Blocks for Lamp-holes and Inlets to Sewers.
WRAGG, T., & SONS, *Burton-on-Trent*, for Gordon's Disconnecting Trap.
WRIGHT BROS., *Leicester*, for Gordon's Ventilating Manhole Covers for Sewers with Annular Dirt Box.
WRIGHT BROS., *Leicester*, for Gordon's Iron Ventilating Cover for Disconnecting Trap.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

B A ASHWELL, F., *Leicester*, Blackman's Air Propeller.
KITE C., & Co., *London*, for Telescoped Wall Inlet Ventilator.
B A PURDY, W., *Nottingham*, Miners' Safety Lamp.
SHARMAN, T., *Leicester*, for Heating Apparatus for Small Greenhouses.
B A VERITY, E. & J., *London*, Crabtree Kitchen Range.
WARNER, J., & SONS, *London*, for Lever Nut for Boiler Cock.
B A WOODHOUSE & RAWSON, *London*, Electric Lighting Appliances.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

ASHWELL, FRANK, *Leicester*, for Steam Kettle with specially arranged Tap for drawing Boiling Water.
BETHELL, T. P., *Liverpool*, for the "Unique" Folding Box.
BOWDEN, W., *London*, for Olive Oil Soap.
CALVERT, F. C., & Co., *Manchester*, for Carbolic Acid Soaps.
CALVERT, F. C., & Co., *Manchester*, for Tooth Soap.
CLARKE, E., & Co., *Battersea*, for "Optimus" Coffee Extract.

A Deferred by the Judges in Competition for Medals.
B Submitted by the Exhibitors for further practical trial.

A COLTMAN, T., *Leicester*, for Conical Knitting Machine.
GENT, J. T., & Co., *Leicester*, for their Exhibit of Electric Bells.
JEYES' SANITARY COMPOUNDS Co., *London*, for Jeyes' Household Disinfecting Soaps.
LEICESTER AMBULANCE CORPS, for Hand Ambulance.
MAIGNEN, P. A., *London*, for the Soldier's Filter.
MAIGNEN, P. A., *London*, for Field Hospital Filter.
MIDLAND EDUCATIONAL Co., *Leicester*, for the "Reliance" Lift-up Desk.
PARR, J., & Co., *Leicester*, for their Exhibit of Bicycles and Tricycles.
STAYNES & SONS, *Leicester*, for Boot and Shoe Uppers.
TAYLOR & Co., *Driffield & London*, for "Simplex" Desk with Adjustable Foot Board.
TORRANCE, W. H., *Edinburgh*, for Rusks, Shortbread, and Oatcakes.
VIPAN & HEADLY, *Leicester*, for Heavy Steel Railway Churn, with Malleable Top and Dust-proof Lid.
A VIPAN & HEADLY, *Leicester*, for Danish Cream Separator.
WRIGHT, A., *London*, for Sanitary Night Lights.

EXHIBITS SELECTED FOR FURTHER PRACTICAL TRIAL.

With regard to the following Exhibits, the Judges are unable to give their decision until they have submitted the Exhibits to a more complete and extended practical examination than is possible at the Exhibition :—

CLASS I.—CONSTRUCTION AND MACHINERY.

B ADAMS, R., *London*, Side Gussets for Fanlights and Reversible Window Fittings.
B ADAMS, R., *London*, "Victor" Silent Spring Butt Hinge.
B BROAD & Co., *Paddington*, White Glazed Bricks.
C B BROAD & Co., *Paddington*, *London*, Rock-buffed Facing Bricks.
B DOULTON & Co., *London*, "Peto" Fireproof Flooring.
B ELLIS, J., & SONS, *Barrow-on-Soar*, Barrow Hydraulic Plaster, Barrow Portland Cement.
B FLETCHER, T., *Warrington*, Washing Machine.
B JENNINGS, T., *Lambeth*, *London*, Hospital Flooring.
MAJOR, H. J. & C., *Bridgewater*, Major's Weather-proof Roofing Tiles.
STERNBERG, J., & Co., *Manchester*, Victory Self-acting Washing Machine, heated by Gas.
B E. SMITH & Co., *Coalville*, Building Bricks and Terra Cotta.
C B THOMPSON & Co., *Walworth*, *London*, Non-poisonous Oxide of Iron Paints.
B WHITE, W., *Abergavenny*, Impervious Wall Lining.
B WHITWICK COLLIERY Co., *Leicester*, Building Bricks.

A Deferred by the Judges in Competition for Medals.
B Submitted by the Exhibitors for further practical trial.
C We have not yet had sufficient opportunity of testing these exhibits, and they are therefore of necessity deferred for a future Report.

WOLSTENHOLME, J., *Manchester*, The Radcliffe Silent Gas Engine.
WORTLEY FIRE-CLAY CO., *Leeds*, White Glazed Bricks.
B WRAGG, T., & SON, *Burton-on-Trent*, White Glazed Bricks.

CLASS II.—SEWERAGE AND WATER SUPPLY.

ADAMS & CO., *York*, Automatic Flush-tank.
ADAMS & CO., *York*, Circular Sewer Ventilator and Manhole Cover.
ADAMS & CO., *York*, Automatic Flushing Cistern for Urinals.
BOWES-SCOTT & READ, *London*, Bower-Barffed Rain-water Pipes.
DOULTON & CO., *London*, Automatic Flush Tank.
DOULTON & CO., *London*, Vacuum Water Waste Preventor.
DOULTON & CO., *Lambeth*, Draw-off Valve for Hot Water.
DYER, F., *London*, Air-tight Manhole Cover.
DYER, F., *London*, Tidal Valve.
FERGUSSON & STARKEY, *Battersea*, Shank's Hot-water Tap.
B ELLIOTT, EDMINSON & OLNEY, *Manchester*, Cold Metal Double-cone Mechanical Lead Pipe Joint.
B HUMPHERSON, F., *Chelsea, London*, Quick Turning Bib Cocks for Hot Water.
B HUMPHERSON, F., *Chelsea, London*, Pipe Joints.
JOHNSON, WALTER F., *Leicester*, Nixon's Hot-water Range Cock.
KNOWLES, J., & CO., *Burton-on-Trent*, Hassell's Joint for Stoneware Pipes.
KNOWLES, J., & CO., *Burton-on-Trent*, Robins' Joints for Stoneware Pipes.
B SWETE, H., M.D., *Worcester*, Safety Anti-vacuum Valves.
B TROTT, H., *Battersea, London*, Bib-valves for hot water.
WARNER, J., & SONS, *London*, Combined Range Cock and Safety Valve.
WARNER, J., & SONS, *London*, "Smeaton's" duplex Waste-not Valve.
WARNER, J., *London*, Gosling's Ejector Syphon Flushing Cistern for Water Closets.
D WORSSAM, G. J., & SONS, *London*, "Colebrooke's" Rotary Pump.
B WRAGG, T., & SONS, *Burton-on-Trent*, Hassell's Joint for Stoneware Pipes.
B WRAGG, T., & SONS, *Burton-on-Trent*, Mawbey's Sanitary Pipe Joint.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

ÆOLUS WATERSPRAY VENTILATING CO., *London*, Æolus Waterspray Ventilator.
ÆOLUS WATERSPRAY VENTILATING CO., *London*, Æolus Exhaust Ventilator.
ÆOLUS WATERSPRAY VENTILATING CO., *London*, Æolus Downcast Ventilator.
ÆOLUS WATERSPRAY VENTILATING CO., *London*, Pollock's Exhaust Ventilator.

B Submitted by the Exhibitors for further practical trial.
D At the Exhibitor's request this Exhibit has been deferred until after the Exhibition at York.

ÆOLUS WATERSPRAY VENTILATING CO., *London*, Pollock's Downcast Ventilator.
ÆOLUS WATERSPRAY VENTILATING CO., *London*, Stafford's Exhaust Ventilator.
ÆOLUS WATERSPRAY & VENTILATING CO., *London*, Ventilating Gas Stove, with brass wire cage.
B ARDEN HILL & CO., *Birmingham*, Acme Gas Cooker, with Boiler.
B ARDEN HILL & CO., *Birmingham*, Acme Artizan Gas Cooker.
B ARDEN HILL & CO., *Birmingham*, Acme Open Gas Fire.
B ARDEN HILL & CO., *Birmingham*, Asbestos Lump Gas Fire.
ASHWELL, F., *Leicester*, Otto Gas Engine.
ASHWELL, F., *Nottingham*, Lancaster Steam Trap.
ASHWELL, F., *Leicester*, Murfet & Dolson's Currugated Fire-bars.
ASHWELL, F., *Leicester*, "Shield's" Air Escape Valves.
B CARTER & LEES, *Oldham*, "Safety" Gas Governor.
B DAVIS, H. C., & CO., *London*, Gas Bath.
B DAVIS, H. C., & CO., *London*, Incandescent Open Gas Fire.
B DAVIS, H. C., & CO., *London*, Metropolitan Gas Cooker, with Boiler.
B DAVIS, H. C. & CO., *London*, Metropolitan Artizan Gas Cooker.
B DOULTON & CO., *Lambeth*, *London*, Bath Heater.
ELLISON, J. E., *Leeds*, Stevens' Exhaust Ventilator.
B EWART & SON, *London*, "Hausbedarf" Water Heater.
B FLETCHER, T., *Warrington*, "Instantaneous" Bath Heater.
B FLETCHER, T., *Warrington*, Lavatory Spiral Water Heater.
B FLETCHER, T., *Warrington*, Open Gas Fire.
B FLETCHER, T., *Warrington*, Asbestos Lump Gas Fire.
B FLETCHER, T., *Warrington*, Gas Cooker, with Boiler.
B FLETCHER, T., *Warrington*, Artizan Gas Cooker.
JOHNSON, W. F., *Leicester*, Imperial Gas Cooker.
KITE & CO., *London*, Exhaust Ventilators.
KITE & CO., *London*, Downcast Ventilators.
KITE & CO., *London*, Lamb's Noiseless Large Volume Fan.
B PATENT SAFETY GAS STOVE CO., *London*, Gas Cooker, with Boiler.
B PATENT SAFETY GAS STOVE CO., *London*, Artizan Gas Cooker.
STIFF, J., & SONS, *London*, "Up-draught" Chimney Cowl.
B THE GENERAL GAS HEATING AND LIGHTING CO., *London*, "Instantaneous" Bath Heater.
B THE GENERAL GAS HEATING AND LIGHTING CO., *London*, "New Patent" Open Gas Fire.
B THE GENERAL GAS HEATING AND LIGHTING CO., *London*, Incandescent Open Gas Fire.
B THE GENERAL GAS HEATING AND LIGHTING CO., *London*, Gas Cooker, with Boiler.
B THE GENERAL GAS HEATING AND LIGHTING CO., *London*, Artizan Gas Cooker.
B WRIGHT & CO., *Birmingham*, Eureka Gas Cooker.
B WRIGHT & CO., *Birmingham*, Artizan Gas Cooker.
B WRIGHT & CO., *Birmingham*, Open Gas Fire.
B WRIGHT & CO., *Birmingham*, Asbestos Lump Gas Fire.

B Submitted by the Exhibitors for further practical trial.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

ARGOSY SILVER CO., *London*, Argosy Silver Plate.
BARSTOW, W., *Pontefract*, Combination Water Filter.
B BINNS & ARMITAGE, *Derby*, "Miller's Pride" Oatmeal.
BOWDEN, W., *London*, Indian and Ceylon Teas.
B BRADFORD, T., & Co., *Manchester*, Black Diamond Boot & Shoe Cleaning Machine.
B DALES, J. T., *London*, Porpoise Oil Dubbin.
B HARRISON, F. J. & Co, *Leicester*, Hydroleine Soap Powder.
B HARRISON, F. J., & Co., *Leicester*, Hydroleine Disinfecting Powder.
MAIGNEN, P. A., *London*, Maignen's Apparatus for use in Softening Water.
B MAWSON & SWAN, *Newcastle-on-Tyne*, Water Filter.
B MARSHALL BROS., *Glasgow*, Semolina and Farola.
B PATENT POROUS CARBON CO., *London*, Porous Carbon for Filtering purposes.
B PAULSON, W., L.R.C.P., *Loughborough*, "Perpetual" Filter.
RICHARDSON, J., & Co., *Leicester*, Sozophane.
RICHARDSON, J., & Co., *Leicester*, Sarcosoze.
RIMMEL, EUGENE, *London*, Toilet Soaps.
STERNBERG, J., & Co., *Manchester*, Milk and Cheese Tester.
B THE PURE WATER CO., *London*, Non-alcoholic Aerated Beverages.
B TURK, R. J., *Kingston-on-Thames*, Cruising Canoe.
B WENHAM GAS LAMP CO., *London*, Wenham Ventilating Gas Burner.

CLASS V.—MISCELLANEOUS.

ASHWELL, F., *Leicester*, Woolpert's Air Tester.
STERNBERG, J., & Co., *Manchester*, Reliance Bronzing Machine.

Several Exhibitors show Stanford's Joint for Stoneware Pipes. For this excellent invention the Medal of the Institute was awarded at the Stafford Congress in 1878, and starred Certificates, equivalent to Medals, have been awarded for it at subsequent Exhibitions. This joint is now so well known and fully appreciated that the Judges do not think it necessary to make any further award for it.

The Cowls and Ventilators of that Class have been deferred for further practical trial, although the Report of the Cowl Committee has not yet been issued, because the investigations of this Committee are now so far advanced that it is anticipated that the Judges will be able to test the Cowls and other similar Ventilators before the next Anniversary Meeting.

(*Signed*) W. H. CORFIELD, M.A., M.D., F.R.C.P., *Chairman*.
H. SAXON SNELL, F.R.I.B.A.
W. EASSIE, C.E., F.L.S., F.G.S.
ROGERS FIELD, B.A., M.Inst.C.E.
ERNEST TURNER, F.R.I.B.A.
J. WALLACE PEGGS, A.M.Inst.C.E.

B Submitted by the Exhibitors for further practical trial.

SUPPLEMENTARY REPORT OF THE JUDGES ON THE EXHIBITS SELECTED FOR FURTHER PRACTICAL TRIAL.

LEICESTER, 1885.

We recommend that the Medals should be awarded to the undermentioned Exhibitors:—

SILVER MEDALS OFFERED BY THE GAS DEPARTMENT OF THE CORPORATION OF LEICESTER.

1. For the best Gas Stove or Gas Apparatus for Cooking purposes for families, including means for heating a good supply of water.

THOMAS FLETCHER, *Thynne Street, Warrington*, for large Gas Cooking Stove with Boiler.

2. For the best Gas Cooking Stove or Gas Apparatus for an artizan's family, for at least six persons.

J. WRIGHT & Co., *Broad Street, Birmingham*, for Eureka Artizan Gas Cooking Stove.

3. For the best and most economical Gas Fire.

THE GENERAL GAS HEATING AND LIGHTING Co., 66, *St. Paul Street, N.*, for Fibre Asbestos Open Gas Fire.

SILVER MEDALS OFFERED BY EXETER GAS COMPANY.

1. For the best Gas Stove or Gas Apparatus for Cooking purposes for families, including a sufficient supply of hot water.

THE GENERAL GAS HEATING AND LIGHTING Co., 66, *St. Paul Street, N.*, for Large Gas Cooking Stove with Boiler.

2. For the best and most economical Gas Fire.

H. & C. DAVIS & Co., 200, *Camberwell Road, S.E.*, for Fibre Asbestos Open Gas Fire.

MEDALS OF THE INSTITUTE.

We recommend that a Medal be awarded to the undermentioned Exhibitor:—

GANDY, MAURICE, *Liverpool*, for Cotton Machine Belting.

This was Exhibited at Dublin, but the testing was not completed in time for the last report.

CLASS I.—

DOULTON & Co., *Lambeth*, for Peto Fireproof Flooring.
SMITH, E. & Co., *Coalville*, for Embossed Tiles.

CLASS III.—

ASHWELL, F., *Leicester*, for Blackman Air Propeller.
THOMAS FLETCHER, *Thynne Street, Warrington*, for Large Gas Cooking Stove with Boiler.
THOMAS FLETCHER, *Thynne Street, Warrington*, for Horizontal Spiral Lavatory Heater.
H. & C. DAVIS & Co., 200, *Camberwell Road, S.E.*, for Artizan Gas Cooking Stove.
GENERAL GAS HEATING AND LIGHTING Co., 66, *St. Paul Street, N.*, for Large Gas Cooking Stove with Boiler.
GENERAL GAS HEATING AND LIGHTING Co., 66, *St. Paul Street, N.*, for Fibre Asbestos Open Gas Fire.
GREENALL, J., *Manchester*, for Steam Washer.
PURDY, W., *Eastwood, Notts.*, for Miners' Safety Lamp.
VERITY, E. & J. M., *Leeds*, for Crabtree's Kitchen Range.
WOODHOUSE & RAWSON, *London*, for their Incandescent Electric Lamp.
J. WRIGHT & Co., *Broad Street, Birmingham*, for Eureka Artizan Gas Cooking Stove.
J. WRIGHT & Co., *Broad Street, Birmingham*, for Lump Asbestos Open Gas Fire.

CLASS IV.—

R. J. TURK, *Kingston-on-Thames*, for Cruising Canoe.

CERTIFICATES OF MERIT.

CLASS I.—

ADAMS, R., *London*, for Side Gussets for Fanlights.
BROAD & Co., *Paddington*, for White Glazed Facing Bricks.
FLETCHER, THOMAS, *Warrington*, for Washing Machine, heated by Gas.
JENNINGS, T., *Lambeth*, for Hospital Flooring.
SMITH, E. & Co., *Coalville*, for Red Building Bricks.
WHITWICK COLLIERY Co., *Coalville*, for Red Building Bricks.

CLASS II.—

ELLIOTT, EDMINSON, & OLNEY, *Manchester*, for Cold Metal Double Cone Mechanical Lead Pipe Joints.
HUMPHERSON & Co., *London*, for Dip Pipe Joint.
TROTT, H., *Battersea*, for Bib Valves for Hot and Cold Water.
WRAGG, T. & SONS, *Burton-on Trent*, for Mawbey's Joint for Stoneware Pipes.

CLASS III.—

ARDEN HILL & Co., *Constitution Hill, Birmingham*, for Lump Asbestos Open Gas Fire.
GENERAL GAS HEATING AND LIGHTING Co., 66, *St. Paul Street, N.*, for Artizan Gas Cooking Stove.
WOODHOUSE & RAWSON, *London*, for their Magnetic Cut Out for Electric Lighting.
J. WRIGHT & Co., *Broad Street, Birmingham*, for large Gas Cooking Stove with boiler.

CLASS IV.—

BINNS & ARMITAGE, *Derby*, for Miller's Pride Oatmeal.
BRADFORD, T. & Co., *Salford*, for Black Diamond Boot and Shoe Cleaning Machine.
DALES, J. T., *London*, for Porpoise Oil Dubbin.
HARRISON, F. J. & Co., *Leicester*, for Hydroleine Soap Powder.
PATENT POROUS CARBON Co., *London*, for Porous Carbon for Filtering Water.

We are unable to recommend the award of the Richardson Medal.

W. H. CORFIELD, M.A., M.D.OXON., CHAIRMAN.
H. C. BARTLETT, PH.D., F.C.S.
F. DE CHAUMONT, M.D., F.R.S.
W. EASSIE, C.E., F.L.S., F.G.S.
ROGERS FIELD, B.A., M.Inst.C.E.
HENRY LAW, M.Inst.C.E.
J. WALLACE PEGGS, A.M.Inst.C.E.
H. SAXON SNELL, F.R.I.B.A.
ERNEST TURNER, F.R.I.B.A.

APPENDIX.

EXAMINATIONS IN SANITARY SCIENCE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

BOARD OF EXAMINERS.

Chairman.

CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

A. WYNTER BLYTH, M.R.C.S.
PROF. W. H. CORFIELD, M.A.LOND., M.D.OXON.
PROF. F. S. B. F. DE CHAUMONT, M.D., F.R.S.
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LOUIS PARKES, M.D.
PROF. H. ROBINSON, M.INST.C.E.
H. SAXON SNELL, F.R.I.B.A.
J. F. J. SYKES, B.SC. PUB. HEALTH, M.B., F.R.C.S.
M. OGLE TARBOTTON, M.INST.C.E., F.G.S.
ERNEST TURNER, F.R.I.B.A.

Registrar.

G. J. SYMONS, F.R.S.

THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances in connection with the various Acts relating to Public Health, the Sale of Food and Drugs, &c., led the Council of the Sanitary Institute of Great Britain to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency to Local Surveyors and Inspectors of Nuisances.

Visitors duly appointed by the Local Government Board and various bodies connected with the practical application of sanitary science are invited to be present at the Examinations.

The Examinations are arranged in two grades, and are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency in the subjects of Examination. A register of Successful Candidates is kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies four hours—viz., from 11 a.m. till 1 p.m., and from 4 till 6 p.m., and consists of written papers only. Inspectors of Nuisances have two hours' written examination on the first day—viz., from 1.30 p.m. till 3.30 p.m. On the second day the Examination, for both classes, commences at 11 a.m.,

and is *vivâ voce*, with one or more questions to be answered in writing, if deemed necessary. A Certificate of Competency, signed by the Examiners, is granted to successful Candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

As one person may, under the Public Health Act, 1875, be both Local Surveyor and Inspector of Nuisances, the Examinations are so arranged that Candidates who desire to do so, *can* enter for both Examinations on the same occasion, but they are not advised so to do.

Candidates are required to furnish the Board of Examiners with satisfactory testimonials as to personal character, and to give two weeks' notice previous to presenting themselves for Examination, stating whether they wish to be examined as Surveyors, as Inspectors of Nuisances, or as both. The fee for Examination must be paid to the Secretary, by Post-Office order or otherwise, at least six days before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

The fees payable for the Examinations are as follows:—

As Surveyors	£5 5s.
As Inspectors of Nuisances . .	£2 2s.

Unsuccessful Candidates are allowed to present themselves a second time without additional payment.

Examinations are appointed to be held for the year 1887:—

On Thursday and Friday, **June 2nd and 3rd.**
On Thursday and Friday, **November 10th and 11th.**

The Forms to be filled up by Candidates and their recommenders previous to Examination will be supplied on application to the Secretary, 74A, Margaret Street, W.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

LAWS AND BYE-LAWS—A thorough knowledge of the Acts affecting Sanitary Authorities, as far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

SEWERAGE AND DRAINAGE—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Sewerage works; the ventilation and flushing of sewers and drains; the internal drainage and other Sanitary arrangements of houses, privies, water-closets, dry-closets, and the removal of refuse; the Sanitary details of Builders' and Plumbers' work.

WATER SUPPLY OF TOWNS AND HOUSES—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

REGULATION OF CELLAR DWELLINGS AND LODGING HOUSES—General principles of Ventilation; the amount of air and space necessary for men and animals; the means of supplying air, and of ensuring its purity.

HIGHWAYS AND STREETS—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

All persons who have passed the above Examination and received the Certificate for Local Surveyors are, by virtue of having so passed, entitled to become Life Members of the Institute, upon payment of Five Guineas, in addition to the fee paid for the Examination.

FOR INSPECTORS OF NUISANCES.

A thorough knowledge of the Provisions of the Acts and Model Bye-Laws relating to the duties of Inspector of Nuisances—also of the working of the Sale of Food and Drugs Act.

A fair knowledge of the principles of Ventilation, and the simple methods of Ventilating Rooms—Measurement of Cubic Space.

A knowledge of the Physical Characteristics of Good Drinking Water—the various ways in which it may be polluted, and the means of preventing pollution—Methods of Water Supply.

A knowledge of the proper conditions of good drainage.

The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' work.

A knowledge of what constitutes a Nuisance, arising from any Trade, Business, or Manufacture.

A fair knowledge of the characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables), so as to be able to recognise unsoundness.

Some knowledge of Infectious Diseases, and of the Regulations affecting persons suffering or recovering from such diseases.

A knowledge of the best Methods of Disinfection.

Methods of Inspection, not only for Dwellings, Cellar Dwellings, Dairies, and Milk-Shops, but of Markets, Slaughter-Houses, Cow-Sheds, and offensive Trades.

Scavenging and the Disposal of Refuse.

All persons who have passed the above Examination and received the Certificate for Inspectors of Nuisances are, by virtue of having so passed, entitled to become Life Associates of the Institute, upon payment of Three Guineas, in addition to the fee paid for the Examination.

EXAMINATIONS FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

The following Candidates received Certificates during the year 1885.

LOCAL SURVEYORS.

June 4, ANGELL, JOHN A., A.M.Inst.C.E., Leytonstone, Essex.
Nov. 13, BERRINGTON, R. E. W., Wolverhampton.
Nov. 13, CRIMP, W. SANTO, A.M.Inst.C.E., Wimbledon.
June 4, FRASER, WILLIAM, Liverpool.
June 4, HOUGHTON, J. MOSELEY, Birmingham.

INSPECTORS OF NUISANCES.

Nov. 13, BARTLETT, W. J., Clerkenwell, E.C.
June 4, BASTIMAN, J., Scarborough.
June 4, BATEMAN, JAMES, Pewsey, Wilts.
June 4, BEEL, J. H., Gosport.
Nov. 13, BUGLER, W. J., Putney, S.W.
Nov. 13, DEE, T. G., Clapham, S.W.
Nov. 13, DIMOND, SOLOMON O., Bristol.
Nov. 13, DYER, SAMUEL, Bridlington Quay.
Nov. 13, EMPTAGE, D., Margate.
Nov. 13, GASKELL, PETER, Hornsea, Hull.
Nov. 13, GOODWYN, ARTHUR A., Highgate Road, N.W.
June 4, GRATY, T. D., Bromley, Kent.
Nov. 13, GRIST, ARTHUR A., South Hackney.
June 4, HART, W. S., Reading.
June 4, HAWKINS, J. T., Chichester.
Nov. 13, HAZELL, JOHN T., Bristol.
Nov. 13, JONES, DAVID H., Llanrwst.

Nov. 13, LOWICK, WILLIAM M., Westbury-on-Trym.
June 4, LOWTHER, THOMAS, Whitby, Yorkshire.
June 4, MITCHELL, COLIN G., Tavistock Street, W.C.
Nov. 13, MORRIS, JOHN E., Bury St. Edmunds.
June 4, PEARSON, JOHN, Newcastle-on-Tyne.
Nov. 13, REAVELL, GEORGE, Jun., Alnwick.
Nov. 13, SIMMONS, NIMROD, Clifton, Bristol.
June 4, SKINNER, JAMES, Brighton.
June 4, SORTWELL, EDWIN, Clapton Park, E.
Nov. 13, STANLEY, ALFRED W., Hull.
June 4, TAIT, JAMES, Paisley.
June 4, THOMPSON, RALPH, Sunderland.
Nov. 13, TREPESS, FRANCIS P., Warwick.
Nov. 13, WESTON, BENJAMIN S., St. Luke's, E.C.
June 4, WILSON, GEORGE, Newark.
Nov. 13, WITTS, THOMAS W., Skelton-in-Cleveland.

EXHIBITIONS OF SANITARY APPARATUS AND APPLIANCES.

THE Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Patents Designs and Trade Marks Act, 1883.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of Merit to such objects as they may consider worthy.

In addition to the Ordinary Medals, a special Medal—the Richardson Medal—is offered by the Institute, for a selected exhibit from the entire exhibition, and will be awarded by the Judges in cases of pre-eminent merit only. Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such trials upon the Exhibitors defraying the necessary expenses.

The Exhibits are arranged in the following Classes:—

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

- Materials and Construction.
- Damp-proof Courses.
- Paints and other Protectives.
- Wall Papers and Coverings.
- Flooring.
- Decorative Materials.
- Machinery adapted for Sanitary Purposes.
- Laundry Appliances.

CLASS II.—WATER SUPPLY AND SEWERAGE.

- Apparatus for Water Supply.
- Filtering and Softening Water.
- Water Waste Preventors.
- Flushing and Watering.
- Sinks.
- Baths and Lavatories.
- Water Closets.
- Urinals.
- Drain Pipes.
- Traps.
- Dry Closets.
- Sewage Treatment.
- Miscellaneous Sanitary Goods.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

- Heating Apparatus.
- Cooking Apparatus.
- Smoke Preventing Appliances.
- Lighting, including Electric Lighting.
- Ventilating Gas Burners.
- Ventilators.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS & DISINFECTANTS.

- Clothing.
- Beds and other Furniture.
- Hospital and Sick Room Appliances.
- Domestic Appliances.
- School Fittings.
- Gymnastic Apparatus.
- Foods.
- Domestic Filters.
- Mineral Waters.
- Soaps and other Detergents.
- Antiseptics and Disinfectants.
- Disinfecting Apparatus.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary interest not included in the above Classes, such as:—

- Scientific Instruments.
- Books and Periodicals.
- Models and Drawings.
- Prevention of Accidents.
- Respirators and Face Guards for Unhealthy Occupations.
- Fire-preventing Appliances.
- Methods for the Disposal of the Dead, &c., &c., &c.

EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.	1885. Leicester.
Number of Exhibitors	117	116	189	106	110	126	134	135
Number of Exhibits	294	319	710	500	600	750	900	1,000
Space occupied (in square ft.)	.....	.....	.....	9,725	14,520	20,000	40,000	30,000
Number of days Exhibition was open	14	16	17	19	25	25	19	17
Total number of Visitors	.....	.....	.....	8,955	8,373	20,000	35,000	37,000
Number of Medals awarded	13	13	12	12	15	21	17	29
Number of Special Certificates	None.	6	9	7	4	13	11	11
Number of Certificates	None.	21	38	40	72	58	84	81
Number of Exhibits deferred for further trial	.....	7	52	30	37	44	39	119

CLASSIFIED LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

Siemens's Regenerative Gas Burner. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Griffiths' Patent White. Silicate Paint Company, *Cannon Street, E.C.* STAFFORD, 1878.
Swann's Incandescent Electric Lamps. J. Edmundson & Co., *Dublin.* DUBLIN, 1884.

SILVER MEDAL.

Offered by the Exeter Gas Company.

Large Gas Cooking Stove with Boiler. The General Gas Heating and Lighting Co., 66, *St. Paul Street, N.* LEICESTER, 1885.
Fibre Asbestos Open Gas Fire. H. & C. Davis & Co., 200, *Camberwell Road, S.E.* LEICESTER, 1885.
Dr. Bond's Euthermic Ventilating Gas Stove. Sanitary & Economic Supply Association, *Gloucester.* EXETER, 1880.
Eureka Gas Cooking Stove. J. Wright & Co., *Birmingham.* DUBLIN, 1884.

SILVER MEDALS OFFERED BY THE GAS DEPARTMENT OF THE CORPORATION OF LEICESTER.

Large Gas Cooking Stove with Boiler. Thomas Fletcher, *Thynne Street, Warrington.* LEICESTER, 1885.
Eureka Artisan Gas Cooking Stove. J. Wright & Co., *Broad Street, Birmingham.* LEICESTER, 1885.
Fibre Asbestos Open Gas Fire. The General Gas Heating and Lighting Co., 66, *St. Paul Street, N.* LEICESTER, 1885.

MEDALS AND SPECIAL CERTIFICATES.

In cases where awards are made at subsequent Exhibitions for the same Exhibits, only the name of the town and date are given. Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals; but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks placed against the name of the town at which the Exhibition was held.

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

(1). Materials and Construction.

Aluminium Crown Metal. Aluminium Crown Metal Co., *Glasgow.* GLASGOW, 1883.
Delta Metal. Alex. Dick, *London.* GLASGOW, 1883.
Artistic Domestic Iron Work, Elgood Bros., *Leicester.* LEICESTER, 1885.
Barrow Blue Lias Hydraulic Lime. J. Ellis & Sons, *Barrow-on-Soar.* LEICESTER, 1885.
Cotton Machine Belting. Maurice Gandy, *Liverpool.* DUBLIN, 1884.
Opener for Fanlights and Skylights. W. & R. Leggott, *Bradford.* LEICESTER, 1885.
Silicate Cotton (Slag-wool). J. A. G. Ross, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Scottish Asbestos. Scottish Asbestos Co., *Glasgow.* GLASGOW, 1883.
Victoria Artificial Stone Paving. Victoria Stone Co., *London.* LEICESTER, 1885.
Damp-proof Concrete Pavement. W. B. Wilkinson & Co. *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Silica Glazed and Enamelled Fire Clay Bricks and Fäience. Willcocks & Co., *Burmantofts, Leeds.* CROYDON, 1879.

(2). Damp-Proof Courses.

No awards.

(3). Paints and other Protectives.

Griffiths' Patent White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquid. Silicate Paint Company, *Cannon Street, E.C.* STAFFORD, 1878.
Leadless "Charlton White" Paint and Dryers. J. B. Orr & Co., *Charlton, London.* GLASGOW, 1883.
Arcanum Process of Silver Plating Steel. Jefferson Read, *Birmingham.* CROYDON, 1879.

(4). Wall Papers and Coverings.

Paper Hangings free from Arsenic. Woollams & Co., *High Street, Marylebone, London.* CROYDON, 1879. *NEWCASTLE, 1882. *GLASGOW, 1883.

(5). Flooring.

Peto Fireproof Flooring. Doulton & Co., *Lambeth.* LEICESTER, 1885.
Economic Hollow Flooring. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878. *CROYDON, 1879.

(6). Decorative Materials.

Art Pottery. Doulton & Co., *London.* DUBLIN, 1884. *LEICESTER, 1885.

Wedgwood Ornamental Tiles. W. B. Morrison, *Glasgow.* GLASGOW, 1883.
Embossed Tiles. E. Smith & Co. LEICESTER, 1885.
Colouring Patterns through the Substance of Wood. H. Chalk Webb, *Worcester.* EXETER, 1880.

(7.) Machinery adapted for Sanitary Purposes.

Improved Six-Ton Steam Road Roller. Aveling & Porter, *Rochester,* CROYDON, 1879.
Fryer's Destructor, Fryer's Carbonizer, and Firman's Dessicating and Rendering Apparatus. Manlove, Alliott, Fryer & Co., *Nottingham.* NEWCASTLE, 1882.

(8). Laundry Appliances.

Improved Washer, with table complete. J. Borwell, *Britannia Foundry, Burton-on-Trent.* LEAMINGTON, 1877.
New "Shuttle" Steam Power Washing Machine. T. Bradford & Co., *London and Manchester.* LEAMINGTON, 1877. *STAFFORD, 1878.
Washing Machines. Thomas Bradford & Co., *London and Manchester.* NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.
Steam Washer. J. Greenall, *Manchester.* LEICESTER, 1885.

CLASS II.—WATER SUPPLY AND SEWERAGE.

(1). Apparatus for Water Supply.

Anti-percussion High Pressure Valves. Doulton & Co., *Lambeth, London.* CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.
Anti-percussion Ball Valve. Doulton & Co., *London.* NEWCASTLE, 1882.
Improvements in Well Sinking Apparatus. Le Grand & Sutcliffe, *Bunhill Row, E.C.* LEAMINGTON, 1877. *CROYDON, 1879.
Buck's Automatic Rain-water Separator. C. G. Roberts, *Haslemere. Surrey.* NEWCASTLE, 1882. *GLASGOW, 1883,
White Enamelled Fireclay Cistern. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* LEICESTER, 1885.

(2). Filtering and Softening Water.

No awards.

(3). Water Waste Preventers.

Direct Acting Valveless Waste Preventer. A. T. Bean, 5, *Cannon Row, S.W.* EXETER, 1880. *NEWCASTLE, 1882.
Siphon-action Water Waste Preventers. Shanks & Co., *Barrhead, N.B.* DUBLIN, 1884.

(4). Flushing and Watering.

No awards.

(5). Sinks.

Enamelled Fireclay Sinks. J. & M. Craig, *Kilmarnock.* DUBLIN, 1884.

(6). Baths and Lavatories.

Porcelain Bath. Joseph Cliff & Sons, *Leeds.* GLASGOW, 1883.
Hot-Air Bath. T. Galbraith, *Crawford Square, Londonderry.* LEAMINGTON, 1877.
Concrete Bath in one piece. W. H. Lascelles, *Bunhill Row, E.C.* CROYDON, 1879. *EXETER, 1880.
Fire-Clay Enamelled Bath. John Hall & Co., *Stourbridge.* GLASGOW, 1883.
Flushing Rim Lavatory Basin and Apparatus. J. Tylor & Sons, *Newgate Street, E.C.* EXETER, 1880.

(7). Water Closets.

"Excelsior" Water Closet. D. T. Bostel, *Duke Street, Brighton.* LEAMINGTON, 1877. *STAFFORD, 1878.
Full-flush Valveless Closet. Hayward, Tyler & Co., *London.* NEWCASTLE, 1882.
"Household" Water Closet. O. D. Ward, *London.* NEWCASTLE, 1882.
" " " H. Trott, *Battersea, London.* *LEICESTER, 1885.

(8). Urinals.

No awards.

(9). Drain Pipes.

Stanford's Joints for Stoneware Pipes. Doulton & Co., *Lambeth, London.* STAFFORD, 1878. *EXETER, 1880.
Stoneware Pipes with Stanford's Joint. J. Stewart, Sen., *Glasgow.* *GLASGOW, 1883.
Acme Sewer Pipes. H. Percy Boulnois, *Portsmouth.* GLASGOW, 1883.

(10). Traps.

Exhibit of Stoneware Disconnecting Traps. J. Stewart, Sen., *Glasgow.* GLASGOW, 1883.

(11). Dry Closets.

Dry Earth Closets. British Sanitary Company, *Glasgow.* NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.
Excreta Pail (oak) with Spring Lid. B. B. Haresceugh & Co., *Bentinck Street, Leeds.* LEAMINGTON, 1877. *STAFFORD, 1878.
Dry Earth or Ashes Closet. R. R. Heap, *Manchester.* GLASGOW, 1883. *DUBLIN, 1884.
Dry Closet, suitable for Ashes or Disinfecting Powder. L. Moser, *Southampton.* EXETER, 1880.

Moule's Earth Closets. Moule's Patent Earth Closet Company, 5*a*, *Garrick Street, W.C.* STAFFORD, 1878. *CROYDON, 1879. *LEICESTER, 1885.

Moule's Earth Closet. Wippell Bros. & Row, 231 and 232, *High Street, Exeter.* *EXETER, 1880.

Dry Earth Closet. J. Parker, *Woodstock, Oxford.* LEAMINGTON, 1877.

Portable Cinder Sifting Ash Closet, with Soil Pail. Sanitary Appliance Company, *Salford.* STAFFORD, 1878. *CROYDON, 1879. *LEICESTER, 1885.

(12). Sewage Treatment.

No awards.

(13). Miscellaneous Sanitary Goods.

Sanitary Appliances, Exhibit of. W. P. Buchan, *Glasgow.* GLASGOW, 1883.

Sanitary and Domestic Appliances, Exhibit of. Maguire & Son, *Dublin.* DUBLIN, 1884.

Roberts's Street Orderly Bin. Sanitary and Highway Appliance Co., *Sheffield.* LEICESTER, 1885.

Roberts's Sand Distributor for 2-horse Tram-track. Sanitary and Highway Appliance Co., *Sheffield.* LEICESTER, 1885.

Sand Distributor for Roads. R. Willacy, *Preston.* LEICESTER, 1885.

(14). Cisterns.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

(1). Heating Apparatus.

Ventilating Tile Stove. Doulton & Co., *Lambeth, London.* EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.

Horizontal Spiral Lavatory Heater. Thomas Fletcher, *Thynne Street, Warrington.* LEICESTER, 1885.

Fibre Asbestos Open Gas Fire. General Gas Heating and Lighting Co., 66, *St. Paul Street, N.* LEICESTER, 1885.

Challenge Hot-water Boiler. J. Keith, *London and Edinburgh.* GLASGOW, 1883.

Slow Combustion Stoves. Musgrave & Co., *Belfast.* DUBLIN, 1884.

Dr. Bond's Euthermic Gas Stove. Sanitary & Economic Supply Association, *Gloucester.* EXETER, 1880.

Lump Asbestos Open Gas Fire. J. Wright & Co., *Broad Street, Birmingham.* LEICESTER, 1885.

(2). Cooking Apparatus.

Apparatus for Cooking by Gas. Billing & Co., *Hatton Garden, E.C.* STAFFORD, 1878. *CROYDON, 1879.

Artisan Gas Cooking Stove. H. & C. Davis & Co., 200, *Camberwell Road, S.E.* LEICESTER, 1885.

Large Gas Cooking Stove with Boiler. Thomas Fletcher, *Thynne Street, Warrington.* LEICESTER, 1885.

Large Gas Cooking Stove with Boiler. General Gas Heating and Lighting Co., 66, *St. Paul Street, N.* LEICESTER, 1885.

Economical Cooking Range. G. H. Harris, *Bristol Street, Birmingham.* LEAMINGTON, 1877. *STAFFORD, 1878.

Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas. Hassall & Singleton, *Birmingham.* STAFFORD, 1878.

Apparatus for Cooking by Gas. S. Leoni & Co., *Strand.* STAFFORD, 1878.

"Sine quâ non" Open and Close Fire Range. A. Shaw & Son, *Glasgow.* GLASGOW, 1883.

Crabtree's Kitchen Range. E. & J. M. Verity, *Leeds.* LEICESTER, 1885.

Artisan Cooking Range. Walker, Turnbull & Co., *Falkirk.* GLASGOW, 1883.

Improved Open or Close Range Kitchener. W. P. Wenham, *Church Street, Croydon.* CROYDON, 1879.

Wilson Portable Close Cooking Range. Wilson Engineering Company, *Holborn, W.C.* EXETER, 1880.

Improved Wilson Range with Steel Boiler and non-conducting Jacketing. Wilson Engineering Company, *London.* NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Eureka Gas Cooking Stove. J. Wright & Co., *Birmingham.* DUBLIN, 1884.

Eureka Artisan Gas Cooking Stove. J. Wright & Co., *Broad Street, Birmingham.* LEICESTER, 1885.

Cooking Range with Revolving Fire for the Prevention of Smoke. Whyte & Bradford, *Bowness.* GLASGOW, 1883.

(3). Smoke Preventing Appliances.

Mechanical Stoker. G. Sinclair, *Leith.* GLASGOW, 1883.

(4). Lighting, including Electric Lighting.

Swann's Incandescent Electric Lights. J. Edmundson & Co., *Dublin.* DUBLIN, 1884.

Prismoidal Pavement and Floor Lights. Hamilton & Co., *Leadenhall Street, E.C.* CROYDON, 1879.

Siemens's Regenerative Gas Burner. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Miners' Safety Lamp. W. Purdy, *Eastwood, Notts.* LEICESTER, 1885.

Mercury Gas Governor. James Stott & Co., *Oldham.* NEWCASTLE, 1882. *LEICESTER, 1885.

"Stott" Gas Governor. A. Brown & Co., *Glasgow.* *GLASGOW, 1883.

Stott's Mercury Gas Governor. Smallman, John L., *Dublin*. *DUBLIN, 1884.

Incandescent Electric Lamp. Woodhouse & Rawson, *London*. LEICESTER, 1885.

(5). Ventilating Gas Burners.

Wenham's Ventilating Gas Lamp. Wenham's Patent Gas Lamp Co., *London*. DUBLIN, 1884.

(6). Ventilators.

Blackman Air Propeller. F. Ashwell, *Leicester*. LEICESTER, 1885.

Conical Ventilators. J. E. Ellison, *Leeds*. STAFFORD, 1878. *CROYDON, 1879. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.

Auto-Pneumatic Ventilation. Nathan Hunt, *Bristol*. EXETER, 1880.

Glass Louvre Ventilators. J. Moore, *St. James' Walk, Clerkenwell, E.C.* EXETER, 1880.

CLASS IV. — PERSONAL HYGIENE, FOODS, FILTERS AND DISINFECTANTS.

(1). Clothing.

Innocuously-dyed Woollen Goods. Donegal Industrial Fund. DUBLIN, 1884.

(2). Beds and other Furniture.

Excelsior Spring Mattress. Chorlton & Dugdale, *Manchester*. LEAMINGTON, 1877. *STAFFORD, 1878. *CROYDON, 1879. *EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

"Swing" Woven Wire Mattress. Chorlton & Dugdale, *Manchester*. DUBLIN, 1884.

"Universal" Invalid Tubular Water and Air Bed. Pocock Bros., *Southwark Bridge Road*. STAFFORD, 1878. *CROYDON, 1879.

Furniture, Exhibit of. Pim Bros., *Dublin*. DUBLIN, 1884.

(3). Hospital and Sick Room Appliances.

Invalid Furniture. J. Carter, 6*a*, *Cavendish Street, W.* EXETER, 1880.

Hospital and Sick Room Appliances, Exhibit of. W. B. Hilliard & Sons, *Glasgow*. GLASGOW, 1883.

Ambulance Wheeled Litter. Maj. F. Duncan, *The Common, Woolwich*. STAFFORD, 1878.

(4). Domestic Appliances.

Machine for Washing and Cooling Butter. F. & C. Hancock, *Dudley, Worcestershire*. LEAMINGTON, 1877. *STAFFORD, 1878.

Exhibit of Machines for Domestic use. F. & C. Hancock, *Dudley, Worcestershire*. GLASGOW, 1883. *LEICESTER, 1885.

Ornamental Domestic Appliances. W. F. Johnson, *Leicester.* LEICESTER, 1885.

Flat Webb Knitting Machine, and Rothwell Knitting Machines, W. Rothwell, *Bolton.* DUBLIN, 1884.

Friction Driving Attachment, for Sewing Machines. Singer Manufacturing Company, *London.* GLASGOW, 1883.

Dairy Appliances, Exhibit of. Vipan & Headly, *Leicester.* LEICESTER, 1885.

(5). School Fittings.

School Furniture. Colman & Glendenning, *Norwich.* EXETER, 1880.

(6). Gymnastic Apparatus.

Bicycles and Tricycles, Exhibit of. Humber & Co., *Nottingham.* LEICESTER, 1885.

Cruising Canoe. R. J. Turk, *Kingston-on-Thames.* LEICESTER, 1885.

(7). Foods.

Powders for Peptonizing Milk. Burroughs, Wellcome & Co., *London.* DUBLIN, 1884.

(8). Domestic Filters.

Filtre Rapide. P. A. Maignen, *Great Tower Street, E.C.* CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.

Bischof's Spongy Iron Filter. Spongy Iron Water Purifying Company, *Oxford Street, W.C.* LEAMINGTON, 1877.

(9). Mineral Waters.

(10). Soaps and other Detergents.

No awards.

(11). Antiseptics and Disinfectants.

Calvert's Carbolic Acid for Disinfecting purposes. Calvert & Co., *Bradford, Manchester.* LEAMINGTON, 1877. *CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.

Jeyes' Perfect Purifier. Jeyes' Sanitary Compounds Co., *London.* LEICESTER, 1885.

Strype's Process for Drying Blood. Dublin and Wicklow Manure Co., *Dublin.* DUBLIN, 1884.

Chemical Substances used for Disinfection. Mackey, Mackey & Co., *London.* DUBLIN, 1884.

Little's Soluble Phenyle. Morris, Little & Co., *Doncaster,* STAFFORD, 1878.

Antiseptic Preparations, Exhibit of. J. Richardson & Co., *Leicester.* LEICESTER, 1885.

Sanitas Oil. Sanitas Company (Limited), *London.* NEWCASTLE, 1882.

Chemical Preparations and Apparatus. Société Française D'Hygiène, *Paris.* LEAMINGTON, 1877.

(12). Disinfecting Apparatus.

Portable Disinfecting Apparatus. Fraser Bros., *Commercial Road, E.* CROYDON, 1879.
Steam Disinfector. J. W. Lyon, *London.* LEICESTER, 1885.
Acid Pump and Syphon. Chas. W. Walker, *Wandsworth Common.* CROYDON, 1879.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary Interest not included in the above Classes, such as :—

(1). Scientific Instruments.

No awards.

(2). Books and Periodicals.

Books on Hygiène. Société Francaise d'Hygiène, *Paris.* NEWCASTLE, 1882.
Sanitary Engineer of New York, Newspaper. H. C. Meyer, *New York.* GLASGOW, 1883.

(3). Models and Drawings.

No awards.

(4). Prevention of Accidents.

"Kredemnon" Life-saving Garments. F. Wentworth & Co., *London.* GLASGOW, 1883.

(5). Respirators and Face Guards for Unhealthy Occupations.

Tyndall's Smoke Respirator. J. Sinclair, *Leadenhall Street, E.C.* CROYDON, 1879.

(6). Fire Preventing Appliances.

(7). Methods for the Disposal of the Dead.

(8.) Sundries.

No awards.

CERTIFICATES AWARDED AT THE EXHIBITIONS.

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

(1). Materials and Construction.

Adjustable Shoe and Regulating Spring Hinge for Swinging Doors. R. Adams, 7, *Great Dover Street, London, S.E.* CROYDON, 1879.
Fanlight Openers and Casement Fasteners. R. Adams, 7, *Great Dover Street, London, S.E.* CROYDON, 1879.
Norton Door Spring. R. Adams, *London.* DUBLIN, 1884.
Adjustable Pivot for Fanlights. R. Adams, *London.* DUBLIN, 1884.
"Victor" Spring Hinge. R. Adams, *London.* LEICESTER, 1885.
Side Gussets for Fanlights. R. Adams, *London.* LEICESTER, 1885.
White Enamelled Bricks. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884.
White Glazed Facing Bricks. Broad & Co., *Paddington.* LEICESTER, 1885.
Granite Vitrified Bricks and Paving. Candy & Co., *Newton Abbot.* EXETER, 1880.
Willesden Waterpoof Paper and Canvas. W. Carson & Sons, *Dublin.* DUBLIN, 1884.
Granite Concrete Pavement. T. Cordingley & Sons, *Bradford,* DUBLIN, 1884.
White Enamelled Bricks. J. & M. Craig, *Kilmarnock.* DUBLIN, 1884.
The Croft Artificial Stone Paving. Croft Stone Quarry & Brick Co., *Croft, Leicestershire.* LEICESTER, 1885.
Silicon Tread For Steps. Doulton & Co., *Lambeth, London.* GLASGOW, 1883. DUBLIN, 1884. LEICESTER, 1885.
Cotton Machine Belting. M. Gandy, *Liverpool.* GLASGOW, 1883.
Steil's Fastener for Machine Belting. M. Gandy, *Liverpool.* GLASGOW, 1883.
Opener for Fanlights and Skylights. W. & R. Leggott, *Bradford.* GLASGOW, 1883. DUBLIN, 1884.
Glazing without Putty. Pennycook Patent Glazing & Engineering Company, *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.
Revolving Shutters, with Balance Weight Motion. Salmon, Barnes & Co., *Ulverston.* EXETER, 1880.
Red Building Bricks. E. Smith & Co., *Coalville.* LEICESTER, 1885.
Hygeian Rock Building Composition. William White, *Abergavenny.* NEWCASTLE, 1882.
Terra Cotta, Exhibit of. Whitwick Colliery Co., *Coalville, Leicester.* LEICESTER, 1885.
Chain Belting for Machinery. W. Wilby, *Dublin.* DUBLIN, 1884.
Red Building Bricks. Whitwick Colliery Co., *Coalville, Leicester.* LEICESTER, 188[illegible]

(2). Damp Proof Courses.

(3). Paints and other Protectives.

No awards.

(4). Wall Papers and Coverings.

"Lincrusta Walton." F. Walton & Co., *London.* GLASGOW, 1883.
Cheap Artistic Non-Arsenical Washable Wall Papers. Thomas Dockrell, Sons & Co., *Dublin.* DUBLIN, 1884.

(5). Flooring.

Parquet Flooring. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Hospital Flooring. T. Jennings, *Lambeth.* LEICESTER, 1885.
Method of Wood Block Flooring. Nightingale & Co., *Great Grimsby.* LEICESTER, 1885.
Solid Oak Parquet Flooring. F. R. Scott & Co., *Dublin.* DUBLIN, 1884.

(6). Decorative Materials.

Decorative Tiles for Covering Walls and Floors. Doulton & Co., *Lambeth, London.* CROYDON, 1879.
Marsden Tiling for Wall Decoration. Maguire & Son, *Dublin.* DUBLIN, 1884.
Repoussé and other Brass Work, Exhibit of. W. F. Johnson, *Leicester.* LEICESTER, 1885.
Photographic Embossed and Incised Tiles. E. Smith & Co., *Coalville, Leicester.* LEICESTER, 1885.
Architectural Terra Cotta, Exhibit of. J. Stiff & Sons, *Lambeth.* LEICESTER, 1885.

(7). Machinery adapted for Sanitary Purposes.

Improved Non-Absorbent Tub or Pail Van. J. B. McCallum, *Stafford.* EXETER, 1880.

(8). Laundry Appliances.

White Enamelled Fireclay Laundry Trough. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884.
Washing Machine, Heated by Gas. Thomas Fletcher, *Warrington.* LEICESTER, 1885.
"Vowel E." Bradford's Family Washing Machine. Garton & King, *Exeter.* EXETER, 1880.
Paragon Washing Machine with Canadian Washer. E. N. Kenworthy & Co., *Oldham.* LEICESTER, 1885.
Paragon Washing Machine with Canadian Washer. Kirsop & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Mitchell's Patent Steam Washer. James Mitchell, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

CLASS II.—WATER SUPPLY AND SEWERAGE.

(1). Apparatus for Water Supply.

Hydraulic Ram. W. Baird, *Dublin*. DUBLIN, 1884.
Latham's Flap Valve. Doulton & Co., *London*. NEWCASTLE, 1882.
Water-taps. J. Fell & Co., *Wolverhampton*. NEWCASTLE, 1882.
Large Way Waste Plug, with Protective Cover. Finch & Co., 181, *High Holborn, W.C.* CROYDON, 1879.
Double Valves for Flow and Return in Hot-water Circulation. Goode & Co., *Loughborough*. LEICESTER, 1885.
Hose Reel. Headley & Sons, *Cambridge*. CROYDON, 1879.
Improved Paragon Valve. W. Ross, *Glasgow*. GLASGOW, 1883.
Bib Valves for Hot and Cold Water. H. Trott, *Battersea*. LEICESTER, 1885.
Improved Full-Way Stop Valve. J. Tylor & Sons, 2, *Newgate Street, E.C.* EXETER, 1880.
Vacuum Flushing Cistern for Closet, with Seat-action Arrangement. Doulton & Co., *Lambeth, London*. DUBLIN, 1884.
Anti-percussion High-pressure Bib Valves. Doulton & Co., *London*, NEWCASTLE, 1882.
Lever Nut for Boiler Cock. J. Warner & Son, *London*. LEICESTER, 1885.

(2). Filtering and Softening Water.

Anti-Calcaire Powders for Softening Water. P. A. Maignen, *London*. GLASGOW, 1883.
Porous Carbon for Filtering Water. Patent Porous Carbon Co., *London*. LEICESTER, 1885.

(3). Water Waste Preventers.

Waste-preventing Flushing Syphon. Henry Watson & Son, *Newcastle-upon-Tyne*. NEWCASTLE, 1882.
Siphon for Water Closet Cisterns. Braithwaite & Co., *Leeds*. CROYDON, 1879.
Bath Locking Valves, for preventing Waste of Water. Doulton & Co., *Lambeth, London*. NEWCASTLE, 1882.
"Waste Not" Regulator Valve. J. Tylor & Sons, 2, *Newgate Street, E.C.* EXETER, 1880. NEWCASTLE, 1882.
Bath Locking Valves for preventing Waste of Water. J. Tylor & Sons, *London*. NEWCASTLE, 1882.

(4). Flushing and Watering.

"Invicta" Flushing Cistern. Goode & Co., *Loughborough*. LEICESTER, 1885.
Siphon Flushing Cistern. F. Humpherson, *Chelsea, London*. LEICESTER, 1885.
Siphon Flushing Cistern. Wright & Stevens. NEWCASTLE, 1882.

(5). Sinks.

Butler's Sink, lined with Block Tin. W. Baird, *Dublin.* DUBLIN, 1884.

White Enamelled Fireclay Sinks. W. Baird, *Dublin.* DUBLIN, 1884.

White Enamelled Fireclay Sinks. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884. LEICESTER, 1885.

White Enamelled Fire Clay Sinks. J. & M. Craig, *Kilmarnock.* NEWCASTLE, 1882. GLASGOW, 1883.

Cheap Glazed Stoneware Sinks. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

"Artisans' Dwellings Sink." G. Jennings, *Stangate, London.* CROYDON, 1879.

White Enamelled Fireclay Sinks. Maguire & Son, *Dublin.* DUBLIN, 1884.

Swivel, Lock Plug, and Overflow for Sinks. Stidder & Co., 50, *Southwark Bridge Road, S.E.* CROYDON, 1879.

Cup Grating for Sinks. Thomasson & Key, *Worcester.* NEWCASTLE, 1882.

Improved Enamelled Iron Slop Sink, with Regulator Supply Valve. J. Tylor & Sons, 2, *Newgate Street, London, E.C.* EXETER, 1880.

Hospital Slop Sink with Waste-not Regulator Valve. J. Tylor & Sons, *London.* NEWCASTLE, 1882.

Slop Sinks. T. Twyford, *Hanley.* DUBLIN, 1884.

Fire-Clay Sanitary Sinks, and Water Troughs. Willcock & Co., *Burmantofts, Leeds.* CROYDON, 1879.

(6). Baths and Lavatories.

Bath, with Shower Douche and Spray Fittings combined. W. Baird, *Dublin.* DUBLIN, 1884.

Lavatory, with Shampooing Apparatus. W. Baird, *Dublin.* DUBLIN, 1884.

Improved Horizontal-Pull Fittings to Baths and Lavatories. W. Baird, *Dublin.* DUBLIN, 1884.

Jennings's Universal Shampooing Apparatus. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Locking Apparatus for Bath Fittings. Doulton & Co,, *Lambeth, London,* DUBLIN, 1884.

Tip-up Lavatory Basin. Doulton & Co., *London.* NEWCASTLE, 1882.

Clark's Anti-splash Tip-up Lavatory Basin. J. Fell & Co., *Wolverhampton.* NEWCASTLE, 1882.

"Shanks's" Porcelain Lavatory Fittings. Fergusson & Starkey, *Leicester.* LEICESTER, 1885.

Shanks's "Eureka" Spray and Plunge Bath. Fergusson & Starkey, *Leicester.* LEICESTER, 1885.

"Unbreakable" Fire-clay Lavatory Basins for Schools, &c. Fergusson & Starkey, *Leicester.* LEICESTER, 1885.

Lavatory. Gillow & Co., *Oxford Street, W.* STAFFORD, 1878.

Well and Dry-Platform Sponge Bath. Groom & Co., *London.* LEICESTER, 1885.

Shower and Douche Bracket. Hayward, Tyler & Co., *London.* NEWCASTLE, 1882.

"Universal" Shampooing Apparatus. G. Jennings, *Stangate, London.* CROYDON, 1879.

Lavatory Basin with Flushing Rim. C. T. Maling, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Enamelled Fire Clay Bath. Rimington Bros. & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Porcelain Baths, moulded and glazed in one piece. Ruffard & Co., *Clay Works, Stourbridge.* STAFFORD, 1878.

Cast Iron Bath. Shanks & Co., *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.

Porcelain Lavatories, with moveable caps for access to fittings. Shanks & Co., *Glasgow.* GLASGOW, 1883. DUBLIN, 1884.

"Eureka" Spray and Plunge Bath. Shanks & Co. *Glasgow.* GLASGOW, 1883.

Lavatory Basins. T. Twyford, *Hanley.* DUBLIN, 1884.

Flushing Rim Lavatory Basin with Quick Waste. J. Tylor & Sons, *London.* NEWCASTLE, 1882.

(7). Water Closets.

Improved Shape of Trough for Water Closets. Adams & Co., *York.* LEICESTER, 1885.

Artisan Closet. Beard, Dent & Hellyer, 21, *Newcastle Street, London, W.C.* CROYDON, 1879.

Economical Flush-Out Closet. Doulton & Co., *Lambeth, London.* EXETER, 1880. NEWCASTLE, 1882.

"Lambeth" Flush-out Closet. Doulton & Co., *Lambeth, London.* GLASGOW, 1883.

"Lambeth" Trough Closet with Automatic Flush Tank. Doulton & Co., *Lambeth, London.* GLASGOW, 1883.

Lambeth Combination Water Closet. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

Economical Combination Closet in two pieces. Doulton & Co., *London.* LEICESTER, 1885.

Improved Seat for Water Closets. E. & A. E. Gilbert, *Broughty Ferry, Forfarshire.* GLASGOW, 1883.

Fowler's Water-closet. W. Harriman & Co., *Blaydon-upon-Tyne.* NEWCASTLE, 1882.

"Beaufort" Flush-down Closet. F. Humpherson, *London.* LEICESTER, 1885.

Wilcock's Automatic Flushing Closet. Maguire & Son, *Dublin.* DUBLIN, 1884.

"National" Water Closet. W. B. Morrison, *Glasgow.* GLASGOW, 1883.

"Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box. J. Tylor & Sons, 2, *Newgate Street, London, E.C.* EXETER, 1880.

Terry's Pedal-action for Water Closets. J. Tylor & Sons, *London.* NEWCASTLE, 1882.

"National" Water Closet. Henry Watson & Son, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

"Crown" Cottage Water Closet. Henry Watson & Son, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

(8). Urinals.

Flush-out Urinal Basin. J. Tylor & Sons, *Newgate Street, London.* NEWCASTLE, 1882.

(9). Drain Pipes.

Large Fire-clay Drain Pipes. Straker & Love, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Stoneware Pipes. Branksea Island Pottery Company (Limited), *Poole, Dorset.* EXETER, 1880.

Improved Drain Pipe with Access Cover. W. P. Buchan, *Glasgow.* NEWCASTLE, 1882.

Salt-glazed Fire-clay Sewer Pipes, Exhibit of. J. Binnie, *Gartcosh, Glasgow.* GLASGOW, 1883.

Stoneware Drain Pipes. Bourtreehill Coal Co., *Dreghorn, Ayrshire.* DUBLIN, 1884.

London-made Stoneware Pipes. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

Cast-iron Drain Pipes, coated with Angus Smith's Preparation. Maguire & Son, *Dublin.* DUBLIN, 1884.

Maguire's Cradle Joint for Drain Pipes. J. & M. Craig, *Kilmarnock.* NEWCASTLE, 1882.

Cast Iron Channels for Stable Drainage. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Joint for Drain Pipes. Doulton & Co., *London.* NEWCASTLE, 1882.

Artificial Stone Tubes. Patent Victoria Stone Company, *Kingsland Road, London, E.* CROYDON, 1879.

Rock Concrete Tubes. Sharpe, Jones & Co., *Bourne Valley Pottery. Poole, Dorset.* CROYDON, 1879.

Mawbey's Joint for Stoneware Pipes. T. Wragg & Sons, *Burton-on-Trent.* LEICESTER, 1885.

(10). Traps.

Potts' Edinburgh Sewer Trap. Adams & Co., *York.* LEICESTER, 1885.

Ventilating Drain Syphon. Beard, Dent & Hellyer, 21, *Newcastle Street, W.C.* CROYDON, 1879.

White Enamelled Fire-clay Gullies. Broad & Co., *Paddington.* LEICESTER, 1885.

Disconnecting Drain Trap. W. P. Buchan, *Glasgow.* NEWCASTLE, 1882. GLASGOW, 1883.

Grease Trap for Kitchen Sinks. W. P. Buchan, *Glasgow.* GLASGOW, 1883.

Buchan's Disconnecting Trap. J. & M. Craig, *Kilmarnock*.
EXETER, 1880. DUBLIN, 1884.

Buchan's Disconnecting Drain Trap and Drain Pipes, with Access Cover. J. & M. Craig, *Kilmarnock*. NEWCASTLE, 1882.

Exhibit of Stoneware Disconnecting Traps. J. & M. Craig, *Kilmarnock*. GLASGOW, 1883.

Disconnecting Gully, with back and side Entrances and iron grating. Doulton & Co., *Lambeth, London*. CROYDON, 1879.

Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating. Doulton & Co., *London*. NEWCASTLE, 1882.

Dean's External Drain Traps, with moveable receptacle. J. C. Edwards, *Trefynant, Ruabon*. CROYDON, 1879.

Gordon's Disconnecting Trap. J. J. Ellis, *Ellistown Collieries*.
LEICESTER, 1885.

Smith's Cast Lead Syphon Traps. J. Fell & Co., *Wolverhampton*.
NEWCASTLE, 1882.

Morris's Cast Iron Gulley, with moveable Dip Pipe. Foster & Pearson, *Nottingham*. LEICESTER, 1885.

Hornibrook's Catchment Grating for Steep Gradients. Hammond & Hussey, *High Street, Croydon*. CROYDON, 1879.

"Eagle" Sanitary Trap, for superseding Bell Traps. Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham*.
CROYDON, 1879.

Edinburgh Air-Chambered Sewer Trap. Potts & Co., *Handsworth, Birmingham*. STAFFORD, 1878.

Dean's Gully Trap. Rimington Bros. & Co., *Newcastle-upon-Tyne*.
NEWCASTLE, 1882.

Disconnecting Chamber for House Drains, with open Stoneware Channels. J. Stewart, Sen., *Glasgow*. GLASGOW, 1883.

Weaver's Ventilating Sewer Air Trap. James Stiff & Sons, *Lambeth, London*. STAFFORD, 1878. LEICESTER, 1885.

Gordon's Disconnecting Trap. T. Wragg & Sons, *Burton-on-Trent*.
LEICESTER, 1885.

(11). Dry Closets.

Self-Acting Earth Closet. British Sanitary Company, *Glasgow*.
EXETER, 1880.

Moser's Self-Acting Dry Closet. J. C. Onions (Limited), *Birmingham*. CROYDON, 1879.

Dry Earth Commode without Separator. J. Parker, *Woodstock*.
EXETER, 1880.

(12). Sewage Treatment.

Iron Basket Sewage-strainer. T. Harnett Harrisson, *Liverpool*.
GLASGOW, 1883.

Pneumatic Liquid Ejector. Isaac Shone, *Wrexham*.
STAFFORD, 1878.

(13). Miscellaneous Sanitary Goods.

Airtight Man-hole Door. A. T. Angell, *London.* NEWCASTLE, 1882. GLASGOW, 1883.

Watts's Asphyxiator for Testing Drains with Smoke. Baird, Thompson & Co., *Glasgow.* DUBLIN, 1884.

White Enamelled Straight and Curved Channels for Inspection Chambers to Drains. Broad & Co., *Paddington.* LEICESTER, 1885.

Brian Jones's Joint for connecting Closet with Soil-pipe. Capper, Son & Co., *London.* NEWCASTLE, 1882.

Enamelled Ware Open Channels for Manholes. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

Manhole for Drains, with connections complete. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

Galvanized Iron Dust-Bin. W. F. Johnson, *Leicester.* LEICESTER, 1885.

Cold Metal Double Cone Mechanical Lead Pipe Joints. Elliott, Edminson, & Olney, *Manchester.* LEICESTER, 1885.

Improved method of connecting Lead Pipes with Stoneware Pipes. T. Harnett Harrisson, *Liverpool.* GLASGOW, 1883.

Clip Pipe Joint. Humpherson & Co., *London.* LEICESTER, 1885.

Night Soil Receptacle with Spring Lid. E. G. Kirk, *Huddersfield.* LEICESTER, 1885.

Sanitary Earthenware. C. T. Maling, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Working Model of Cattle Drinking Trough. R. Pringle, M.D., *Blackheath.* LEICESTER, 1885.

Drain-cleaning Rods, and Stoneware Horse Manger. Oates & Green, *Horley Green Fire Clay Works, Halifax.* STAFFORD, 1878.

Roberts's Asphalte Cauldron. Sanitary & Highway Appliance Co., *Sheffield.* LEICESTER, 1885.

Closed Sectional Sanitary Van. J. Smith & Sons, *Wolverhampton.* LEICESTER, 1885.

India-Rubber Connection for joining Lead and Earthenware Pipes. T. Twyford, *Hanley.* DUBLIN, 1884.

Joint for Lead Pipes. J. Tylor & Sons, 21, *Newgate Street, London.* NEWCASTLE, 1882.

White Enamelled Straight and Curved Channels, and Channel Junctions for Inspection Chambers to Drains. Wortley Fire Clay Co., *Leeds.* LEICESTER, 1885.

Gordon's Junction Blocks for Lamp-holes and Inlets to Sewers. T. Wragg & Sons, *Burton-on-Trent.* LEICESTER, 1885.

Gordon's Ventilating Manhole Covers for Sewers with Annular Dirt Box. Wright Bros., *Leicester.* LEICESTER, 1885.

Gordon's Iron Ventilating Cover for Disconnecting Trap. Wright Bros., *Leicester.* LEICESTER, 1885.

CLASS III.—HEATING, LIGHTING AND VENTILATING.

(1). Heating Apparatus.

Gas Cooking Stove, lined with White Tiles. Arden Hill & Co., *Birmingham.* DUBLIN, 1884.

Lump Asbestos Open Gas Fire. Arden Hill & Co., *Constitution Hill, Birmingham.* LEICESTER, 1885.

Steam Kettle with specially arranged Tap for drawing Boiling Water. Frank Ashwell, *Leicester.* LEICESTER, 1885.

Silicate Cotton Composition for Covering Steam Pipes. C. Cadle, *Dublin.* DUBLIN, 1884.

Tortoise Slow Combustion Stoves. W. Carson & Sons, *Dublin.* DUBLIN, 1884.

George's Calorigen. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Grates, Mantelpieces, and Over-mantels. Dinning & Cooke, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Glazed Ware Mantelpiece, with Slow Combustion Grate. Doulton & Co., *Lambeth, London.* DUBLIN, 1884.

Tortoise Slow Combustion Stoves. Hydes & Wigfull, *Sheffield.* GLASGOW, 1883.

Tortoise Laundry Stove. Hydes & Wigfull, *Sheffield.* GLASGOW, 1883.

Laundry Stove and Copper Boiler. Maguire & Son, *Dublin.* DUBLIN, 1884.

Steam Heating Apparatus, combining heating and ventilating. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.

Warming and Ventilating Appliances. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878.

Corrugated Iron Hot-Water Warming Appliances. G. E. Pritchett, 20, *Spring Gardens, S.W.* EXETER, 1880.

Heating Apparatus for Small Greenhouses. T. Sharman, *Leicester.* LEICESTER, 1885.

Thermhydric Ventilating Hot-water Open Fire Grate. H. Saxon Snell, *Southampton Buildings.* STAFFORD, 1878.

Tubular-Calorifer for Greenhouses. William Thornburn, *Borough Bridge.* NEWCASTLE, 1882.

Conservatory Boiler, with Hot-Water Pipe. Wippell Bros. & Row, *Exeter.* EXETER, 1880.

"Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing. John Wright & Co., *Birmingham.* NEWCASTLE, 1882.

Ventilating Open Gas Fire. J. Wright & Co., *Birmingham.* DUBLIN, 1884.

(2). Cooking Apparatus.

Solid Flame Boiling Stove. Arden Hill & Co., *Birmingham.* NEWCASTLE, 1882.

Combined Close Fire and Gas Cooking Range. Carron Co., *Falkirk.* GLASGOW, 1883.

"Sunlight Stove." Chorlton & Dugdale, 19, *Blackfriars Street, Manchester.* EXETER, 1880.
Devonshire Cooking Range. T. J. Constantine, *Fleet Street, E.C.* EXETER, 1880.
Artisan Gas Cooking Stove. General Gas Heating and Lighting Co., 66, *St. Paul Street, N.* LEICESTER, 1885.
Tin Cooking Utensils. Mrs. A. Lewis, *Manchester.* CROYDON, 1879.
Dow's Close and Open Fire Cooking Range. W. McGeoch & Co., *Glasgow.* GLASGOW, 1883.
Simplex Cooking Range. Walker, Turnbull & Co., *Falkirk.* GLASGOW, 1883.
Cooking Stove with Warm-Air Chamber. Thos. Waller, 47, *Fish Street Hill, E.C.* CROYDON, 1879.
Cottage Range. Wippell Bros. & Row, *Exeter.* EXETER, 1880.
Large Gas Cooking Stove with Boiler. J. Wright & Co., *Broad Street, Birmingham.* LEICESTER, 1885.

(3). Smoke Preventing Appliances.

Open Grate for consuming Smoke. James Smith, *Liverpool.* NEWCASTLE, 1882.

(4). Lighting, including Electric Lighting.

Improved Gas Burners. Bray & Co., *Blackman Lane, Leeds.* CROYDON, 1879.
Portable Gas Apparatus for Manufacturing Gas from Gasoline. F. W. Clarke's Portable Gas Apparatus Company (Limited), *Great Queen Street, London, W.C.* CROYDON, 1879.
Albo Carbon Light. William Forrest, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Albo-Carbon Light. Osbert Henderson, *Glasgow.* GLASGOW, 1883.
Duplex Burner. T. Heron, *Manchester,* NEWCASTLE, 1882.
"Rheo-meter" Street Lamp Regulator. S. Leoni & Co., *Strand, W.C.* STAFFORD, 1878.
Hink's Duplex Lamp with Extinguisher. Mather & Armstrong, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
"Milwaukee" Glass Lantern or Hurricane Lantern. S. E. Ransome & Co., 10, *Essex Street, W.C.* CROYDON, 1879.
Gaseliers and Gas Brackets. Willey & Co., *Exeter.* EXETER, 1880.
Chappuis Daylight Reflector. Wippell Bros. & Row, 231, *High Street, Exeter.* EXETER, 1880.
Magnetic Cut Out for Electric Lighting. Woodhouse & Rawson, *London.* LEICESTER, 1885.

(5). Ventilating Gas Burners.

No awards.

(6). Ventilators.

Method of Costless Ventilation. Peter Hinckes Bird, 1, *Norfolk Square, W.* CROYDON, 1879.

Glass Revolving and Sliding Ventilators. H. W. Cooper & Co., *London.* GLASGOW, 1883.
Air Inlet Head for Drain Ventilation. H. S. Cregeen, *Bromley.* NEWCASTLE, 1882.
"Radiator" Ventilator, with Screw Action. J. E. Ellison, *Leeds.* GLASGOW, 1883. DUBLIN, 1884.
Double Current Ventilators. Hill & Hey, *Halifax.* GLASGOW, 1883.
Outlet Ventilator. C. Kite & Co., *London.* NEWCASTLE, 1882.
Noiseless Chimney Breast Outlet Ventilator. Kite & Co., *London.* GLASGOW, 1883. DUBLIN, 1884.
Wall Inlet Ventilator. C. Kite & Co., *London.* GLASGOW, 1883. DUBLIN, 1884.
Telescoped Wall Inlet Ventilator. C. Kite & Co., *London.* LEICESTER, 1885.
"Imperial" Ventilating Window. U. Knell, 77, *Fore Street, E.C.* CROYDON, 1879.
Morgan's Stench Exhaust. Nailsworth Foundry Company, *Bristol.* NEWCASTLE, 1882.
Ventilating and Warming Appliances. G. E. Pritchett, 20, *Spring Gardens, S. W.* STAFFORD, 1878.
Ransome's Artificial Stone Air Brick. Wippell Bros. & Row, 231, *High Street, Exeter.* EXETER, 1880.
Ornamental Inlet Ventilators. C. H. Sharp & Co., *High Holborn, E.C.* EXETER, 1880.
Boyle's Mica-Valved Outlet Ventilator. Wenham & Co., *Church Street, Croydon.* CROYDON, 1879.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

(1.) Clothing.

Crocodile Hide Leather. Borough Leather Warehouse Co., *London.* GLASGOW, 1883.
Ventilatorium Waterproof Garments. Bartrum, Harvey & Co., *London.* STAFFORD, 1878.
Ventilated Hats. W. Graham, *Dublin.* DUBLIN, 1884.
Improved shape of Boot. J. Hotblack & Son, *Norwich.* DUBLIN, 1884.
Pith Helmet. J. Morgan, *Dublin.* DUBLIN, 1884.
Rhinoceros Hide "S" Boot. Patrick Short, *Dublin.* DUBLIN, 1884.
Boot and Shoe Uppers. Staynes & Sons, *Leicester.* LEICESTER, 1885.
Furs. Brooke Tyrrell, *Dublin.* DUBLIN, 1884.
"Natural" Boot for Ladies. A. Webb, *Dublin.* DUBLIN, 1884.

(2). Beds and other Furniture.

Spring Mattresses. Billington Bros., *Liverpool.* GLASGOW, 1883.
Portable Bed, with Liverpool Spring Mattress. Billington Bros., *Liverpool.* DUBLIN, 1884.

Central Tube Water Mattress. Brady & Martin, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Bed Rest with Movable Arms. Willam Brock & Co., 177, *Fore Street, Exeter.* EXETER, 1880.
"Nonsuch" Adjustable Chair. Willam Brock & Co., 177, *Fore Street, Exeter.* EXETER, 1880.
Spring Mattress. Bussey & Co., *Museum Works, Peckham, S.E.* CROYDON, 1879.
"Excelsior" Ships' Berth. Chorlton & Dugdale, *Manchester.* GLASGOW, 1883.
Pitch Pine Lath Mattress. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.
Automaton Seat for Drapers. Colman & Glendenning, *Norwich.* EXETER, 1880.
Combination Bedstead. W. Fleming, *Dublin.* DUBLIN, 1884.
Spring Mattress. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Invalid "Grasshopper" Couch. William Hamilton, *Brighton.* STAFFORD, 1878. NEWCASTLE, 1882.
Institution Bed, with Woven-Wire Mattress. Pearson & Co., *Dublin.* DUBLIN, 1884.
Hinged Cot. Pim Bros., *Dublin.* DUBLIN, 1884.
Furniture. Scott & Co., *Dublin.* DUBLIN, 1884.
Fernby's "Paragon" Camp Furniture. Wippell Bros. & Row, *Exeter.* EXETER, 1880.

(3). Hospital and Sick Room Appliances.

Metallic Tubular Bedsteads and Invalid Bed Rests. Thomas Allen, *St. Augustine's Parade, Bristol.* STAFFORD, 1878.
Folding Invalid Bed. Ancell Ball, *Spalding.* CROYDON, 1879.
Absorbent Cotton and Antiseptic Sponges. Burroughs, Wellcome & Co., *London.* DUBLIN, 1884.
"Invalid's" Adjustable Bed. Chorlton & Dugdale, *Manchester.* EXETER, 1880.
Hospital Bed, fitted with Raising Appliances. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.
Hospital Bed, with new Spring Mattress. Chorlton & Dugdale, *Manchester.* DUBLIN, 1884.
Self-acting Sick Bed. E. K. Groves, *Bristol.* GLASGOW, 1883.
Burn and Wound Boxes. W. B. Hilliard & Sons, *Glasgow.* GLASGOW, 1883.
Isolating Curtain. W. B. Hilliard & Sons, *Glasgow* GLASGOW, 1883.
India Rubber Vessels for hospital use. H. A. Murton, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
China Cups and other Vessels for invalid use. Townsend & Co., *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
Stypium Absorbent Antiseptic Surgical Dressings. Stephenson & Travis, *Liverpool.* DUBLIN, 1884.

(4). Domestic Appliances.

"Unique" Folding Box. T. P. Bethell, *Liverpool.* LEICESTER, 1885.
Automatic Chariot for Children. William Bowden, *London,* NEWCASTLE, 1882.
Revolving Shuttle for Sewing Machines. Bradbury & Co., *Oldham.* GLASGOW, 1883.
Black Diamond Boot and Shoe Cleaning Machine. T. Bradford & Co., *Salford.* LEICESTER, 1885.
Conical Knitting Machine. T. Coltman, *Leicester.* LEICESTER, 1885.
Electric Bells, Exhibit of. J. T. Gent & Co., *Leicester.* LEICESTER, 1885.
Compostella Fire Lights for Lighting Fires. Compostella Fire Light Company, *Fenchurch Street, E.C.* STAFFORD, 1878.
Porpoise Oil Dubbin. J. T. Dales, *London.* LEICESTER, 1885.
Bower's Potato Steamer. Groom & Co., *London.* DUBLIN, 1884.
Self-Indicating Tea or Coffee Infuser. Groom & Co., *London.* DUBLIN, 1884.
Stoneware Churns. F. Grosvenor, *Glasgow.* GLASGOW, 1883.
Dough Kneading Machine. F. & C. Hancock, *Dudley, Worcester.* EXETER, 1880.
New Propellor Churn. F. & C. Hancock, *Dudley, Worcester.* EXETER, 1880.
Machine for Washing and Peeling Potatoes. F. & C. Hancock, *Dudley.* NEWCASTLE, 1882.
Knitting Machines. Harrison Patent Knitting Machine Co., *Manchester.* DUBLIN, 1884.
Pendulous Food Warmers. Osbert Henderson, *Glasgow.* GLASGOW, 1883.
Various Inventions for Promoting Domestic Economy. W. H. Hilton, *Leamington.* STAFFORD, 1878.
India Rubber Gas Tubing. A. Hutchinson & Co., *Great Winchester Street, London, E.C.* EXETER, 1880.
Victoria Knitting Machine. Pim Bros. Limited, *Dublin.* DUBLIN, 1884.
Heavy Steel Railway Churn, with Malleable Top and Dust-proof Lid. Vipan & Headly, *Leicester.* LEICESTER, 1885.
Danish Cream Separator. Vipan & Headly, *Leicester.* LEICESTER, 1885.
"Noiseless Ware." Vernon's Patent China and Glass Company, *London.* GLASGOW, 1883.
Improved Housemaid's Box with Sifter. Wippell Bros. & Row, *High Street, Exeter.* EXETER, 1880.

(5). School Fittings.

School Desks with Shifting Seats. Colman & Glendenning, *Norwich.* STAFFORD, 1878.
Dual Desk, with Separate Gangway Seat. Thomas Larmouth & Co. *Salford.* STAFFORD, 1878.
"Reliance" Lift-up Desk. Midland Educational Co., *Leicester.* LEICESTER, 1885.
"Simplex" Desk with Adjustable Foot Board. Taylor & Co., *Driffield & London.* LEICESTER, 1885.

(6). Gymnastic Apparatus.

Tricycles, W. Carson & Sons, *Dublin.* DUBLIN, 1884.
Tricycles. Fletcher Bros., *Dublin.* DUBLIN, 1884.
Bicycles and Tricycles, Exhibit of. J. Parr & Co., *Leicester.* LEICESTER, 1885.

(7). Foods.

Soluble Dutch Cocoa. Bensdorp & Co., *London.* DUBLIN, 1884.
Pickles and Sauces. Beveridge & Co., *Glasgow.* GLASGOW, 1883.
Miller's Pride Oatmeal. Binns & Armitage, *Derby.* LEICESTER, 1885.
Kepler's Extract of Malt and Combinations of it with Pepsine, Chocolate, and Cod Liver Oil. Burroughs, Wellcome & Co., *London.* DUBLIN, 1884.
Optimus Coffee Extract. E. Clarke & Co., *Battersea.* DUBLIN, 1884. LEICESTER, 1885.
Currie Powders. J. Edmunds, *London.* NEWCASTLE, 1882.
Cocoa Extract and Preparations of Chocolate. J. S. Fry & Sons, *Union Street, Bristol.* EXETER, 1880.
Indian Tea. Indian Tea Co., *Glasgow.* GLASGOW, 1883.
Mustard. Irvine & Co., *Gateshead.* NEWCASTLE, 1882. GLASGOW, 1883.
Midlothian Oat Flour. A. & R. Scott, *Glasgow.* GLASGOW, 1883.
Rusks, Shortbread, and Oatcakes. W. H. Torrance, *Edinburgh.* LEICESTER, 1885.

(8). Domestic Filters.

"Bijou" Filtre Rapide. P. A. Maignen, *Great Tower Street, London, E.C.* EXETER, 1880.
Improved Filtre Rapide. P. A. Maignen, *Great Tower Street, E.C.* NEWCASTLE, 1882.
Soldier's Filter. P. A. Maignen, *London.* LEICESTER, 1885.
Field Hospital Filter. P. A. Maignen, *London.* LEICESTER, 1885.
Silicated Carbon Double Chambered Table Filters. Silicated Carbon Filter Company, *Battersea, London.* EXETER, 1880.
Silicated Carbon Filtering Material. Silicated Carbon Filter Company, *London.* NEWCASTLE, 1882.
Carbonised Iron Stone Mound Filter for Water. J. A. Stephan, *Worcester.* EXETER, 1880.
Artificial Stone Filters, for Cleansing Rain Water for Domestic Use. Thorn & Co., *Stafford.* STAFFORD, 1878.

(9). Mineral Waters.

Potash, Soda and Seltzer Waters and Lemonade. British Mineral Water Company, *Glasgow.* NEWCASTLE, 1882.
Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic. Carter & Co., *Old Refinery, Bristol.* EXETER, 1880.
Zoedone. (Patentee, David Johnson, F.C.S.) Evans & Co., *Wrexham.* CROYDON, 1879.
Lemonade, Lime Juice, and Ginger Ale. Gulliver & Co., *Aylesbury.* CROYDON, 1879.

Seltzer Water. Jewsbury & Brown, *Manchester*. STAFFORD, 1878.
Ginger Ale and Lemonade. Newry Mineral Water Company (Limited), *Liverpool*. CROYDON, 1879.
Seltzer, Soda, and Potash Waters, and Orange Quinine Tonic G. H. Skinner, 13, *North Street, Exeter*. EXETER, 1880.

(10). Soaps and other Detergents.

Olive Oil Soap. W. Bowden, *London*. LEICESTER, 1885.
Soaps. S. Boyd, *Dublin*. DUBLIN, 1884.
Carbolic Soaps. F. C. Calvert & Co., *Manchester*. DUBLIN, 1884. LEICESTER, 1885.
Hydroleine Soap Powder. F. J. Harrison & Co., *Leicester*. LEICESTER, 1885.
Tooth Soap. F. C. Calvert & Co., *Manchester*. LEICESTER, 1885.
Jeyes' Household Disinfecting Soaps. Jeyes' Sanitary Compounds Co., *London*. LEICESTER, 1885.

(11). Antiseptics and Disinfectants.

Red Cross Yellow Fluid. Antiseptic Apparatus Manufacturing Co. *London*. NEWCASTLE, 1882.
Chemical Substances used in Disinfection. S. Boyd, *Dublin*. DUBLIN, 1884.
50°/₀ Carbolic Disinfecting Powder. F. C. Calvert & Co., *Manchester*. GLASGOW, 1883.
Soluble Cresol. F. C. Calvert & Co., *Manchester*. DUBLIN, 1884.
Alum Cake. Dublin and Wicklow Manure Co., *Dublin*. DUBLIN, 1884.
Jeyes' Perfect Purifier. Jeyes' Sanitary Compounds Company, *Bishopsgate Street, London, E.C.* CROYDON, 1879. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.
Pixene. J. Wheeler, *Ilfracombe*. GLASGOW, 1883. DUBLIN, 1884.
Sanitary Night Lights. A. Wright, *London*. LEICESTER, 1885.

(12) Disinfecting Apparatus.

Improved Vaporiser for Disinfecting. F. C. Calvert & Co., *Manchester*. EXETER, 1880.
Dr. Scott's Disinfecting Apparatus. Maguire & Son, *Dublin*. NEWCASTLE, 1882. DUBLIN, 1884.
Lyon's Disinfector. Manlove, Alliott, Fryer & Co., *Nottingham*. NEWCASTLE, 1882.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary interest not included in the above Classes, such as :—

(1). Scientific Instruments.

Large Legible Spirit Thermometer. P. Hinckes Bird, 1, *Norfolk Square, London, N.W.* EXETER, 1880.

Instruments used by Medical Officers of Health. Brady & Martin, *Newcastle-upon-Tyne.* NEWCASTLE, 1882.
New Oven Pyrometer. Joseph Davis & Co., *London.* NEWCASTLE, 1882.
Thermometrical Instruments. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* STAFFORD, 1878.
Barometrical and Thermometrical Instruments. G. E. Pritchett, 20, *Spring Gardens, London, S.W.* CROYDON, 1879.
Improvements in Thermometrical and Barometrical Instruments, G. E. Pritchett, 20, *Spring Gardens, S.W.* EXETER, 1880.
Webster's Photometer. Webster & Co., *Nottingham.* CROYDON, 1879.

(2). Books and Periodicals.

Exhibit of Drawings and Books Relating to Disposal of Sewage in Paris. A. Durand Claye, *Paris.* GLASGOW, 1883.
Publications. Ladies' Sanitary Association, *Berners Street, London, W.* STAFFORD, 1878.
Sanitary Publications. Smith, Elder, & Co., *London.* NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.

(3). Models and Drawings.

No awards.

(4). Prevention of Accidents.

Leander Life Belt. J. W. Elvery & Co., *Dublin.* DUBLIN, 1884.
Method of Rendering Timber Non-inflammable. A. Gardner & Son, *Glasgow.* GLASGOW, 1883.
Hand Ambulance. Leicester Ambulance Corps, *Leicester.* LEICESTER, 1885.
Safety Belt Shippers. Selig, Sonnenthal & Co. (Limited), *Lambeth Hill, Queen Victoria Street, London, E.C.* CROYDON, 1879.

(5). Respirators and Face Guards for Unhealthy Occupations.

No awards.

(6). Fire Preventing Appliances.

Dicks' L'Extincteur. J. Hildesheim, *Glasgow.* GLASGOW, 1883.
Chemical Fire Exterminator. J. Sinclair, 104, *Leadenhall Street, London, E.C.* CROYDON, 1879.

(7). Methods for the Disposal of the Dead.

"Earth to Earth" Coffins. London Necropolis Company, *Strand, London, W.C.* STAFFORD, 1878.
Folding Bier and Car for Simplifying Funerals. S. Stretton, *Kidderminster.* CROYDON, 1879.

ALPHABETICAL LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

Edmundson, J., & Co., *Dublin*, for Swann's Incandescent Electric Lamps. DUBLIN, 1884.

Messrs. Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner. NEWCASTLE, 1882.

Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' Patent White. STAFFORD, 1878.

SILVER MEDALS.

Offered by the Gas Department of the Corporation of Leicester.

Fletcher, Thomas, *Thynne Street, Warrington*, for Large Gas Cooking Stove with Boiler. LEICESTER, 1885.

The General Gas Heating and Lighting Co., 66, *St. Paul Street, N.*, for Fibre Asbestos Open Gas Fire. LEICESTER, 1885.

Wright, J., & Co., *Broad Street, Birmingham*, for Eureka Artisan Gas Cooking Stove. LEICESTER, 1885.

SILVER MEDALS.

Offered by the Exeter Gas Company.

Davis, H. & C., & Co.. 200, *Camberwell Road, S.E.*, for FibreAsbestos Open Gas Fire. LEICESTER, 1885.

The General Gas Heating and Lighting Co., 66, *St. Paul Street, N.*, for Large Gas Cooking Stove with Boiler. LEICESTER, 1885.

Sanitary and Economic Supply Association, for Dr. Bond's Euthermic Ventilating Gas Stove. EXETER, 1880.

Wright, J. & Co., *Birmingham*, for Eureka Gas Cooking Stove. DUBLIN, 1884.

MEDALS AND SPECIAL CERTIFICATES.

In cases where awards are made at subsequent Exhibitions for the same Exhibits, only the name of the town and date are given. Exhibits which have already received Medals at previous Exhibitions of the Institute are excluded from awards of Medals; but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks placed against the name of the town at which the Exhibition was held.

Aluminium Crown Metal Co., *Glasgow.*, for Aluminium Crown Metal, GLASGOW, 1883.

Ashwell, F., *Leicester*, for Blackman Air Propeller. LEICESTER, 1885.
Aveling & Porter, *Rochester*, for Improved Six-Ton Steam Road Roller. CROYDON, 1879.
Bean, A. T., 5, *Cannon Row, S.W.*, for Direct Acting Valveless Waste Preventer. EXETER, 1880.
Billing & Co., *Hatton Garden, E.C.*, for Apparatus for Cooking by Gas. STAFFORD, 1878. *CROYDON, 1879.
Borwell, J., *Britannia Foundry, Burton-on-Trent*, for Improved Washer, with table complete. LEAMINGTON, 1877.
Bostel, D. T., *Duke Street, Brighton*, for Excelsior Water Closet. LEAMINGTON, 1877. *STAFFORD, 1878.
Boulnois, H. Percy, *Portsmouth*, for "Acme" Sewer Pipes. GLASGOW, 1883.
Bourtreehill Coal Co., *Dreghorn, Ayrshire*, for White Enamelled Fireclay Cistern. LEICESTER, 1885.
Bradford, T. & Co., *High Holborn, W.C.*, for New "Shuttle" Steam Power Washing Machine. LEAMINGTON, 1877. *STAFFORD, 1878.
" " for Washing Machines. NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.
British Sanitary Company, *Glasgow*, for Dry Earth Closet. NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.
Brown, A. & Co., *Glasgow*, for "Stott" Gas Burner. *GLASGOW, 1883.
Buchan, W. P., *Glasgow*, for his exhibit of Sanitary Appliances. GLASGOW, 1883.
Burroughs, Wellcome & Co., *London*, for Powders for Peptonizing Milk. DUBLIN, 1884.
" " *London*, for Kepler's Extract of Malt, and combinations of it with Pepsine, Chocolate, and Cod Liver Oil. DUBLIN, 1884.
Calvert & Co., *Bradford*, for Calvert's Carbolic Acid for disinfecting purposes. LEAMINGTON, 1877. *CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.
Carter, J., 6*a*, *Cavendish Street, W.*, for Invalid Furniture. EXETER, 1880.
Chorlton & Dugdale, *Manchester*, for Excelsior Spring Mattress. LEAMINGTON, 1877. *STAFFORD, 1878. *CROYDON, 1879. *EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.
" " for "Swing" Woven Wire Mattress. DUBLIN, 1884.
Cliff, Joseph & Sons, *Leeds*, for Porcelain Bath. GLASGOW, 1883.
Colman & Glendenning, *Norwich*, for School Furniture. EXETER, 1880.
Craig, J. & M., *Kilmarnock, N.B.*, for Enamelled Fireclay Sinks. DUBLIN, 1884.
Davis, H. & C., & Co., 200, *Camberwell Road, S.E.*, for Artisan Gas Cooking Stove. LEICESTER, 1885.

Dick, Alex., *London*, for Delta Metal. GLASGOW, 1883.
Donegal Industrial Fund, for Innocuously-dyed Woollen Goods. DUBLIN, 1884.
Doulton & Co., *Lambeth, London*, for Stanford's Joints for Stoneware Pipes. STAFFORD, 1878. *EXETER, 1880.
" " for Anti-Percussion High Pressure Valves. CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884.
" " for Ventilating Tile Stove. EXETER, 1880. *NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.
" " for Anti-Percussion Ball Valve. NEWCASTLE, 1882.
" " for Art Pottery. DUBLIN, 1884. *LEICESTER, 1885.
" " for Peto Fireproof Flooring. LEICESTER, 1885.
Dublin & Wicklow Manure Co., *Dublin*, for Strype's Process for Drying Blood. DUBLIN, 1884.
Duncan, Maj. F., *The Common, Woolwich*, for Ambulance Wheeled Litter. STAFFORD, 1878.
Edmundson, J. & Co., *Dublin*, for their Exhibit of Swann's Incandescent Electric Lights. DUBLIN, 1884.
Elgood, Bros., *Leicester*, for Artistic Domestic Iron Work. LEICESTER, 1885.
Ellis, J., & Sons, *Barrow-on-Soar*, for Barrow Blue Lias Hydraulic Lime. LEICESTER, 1885.
Ellison, J. E., *Leeds*, for Conical Ventilators. STAFFORD, 1878. *CROYDON, 1879. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.
Fletcher, Thomas, *Thynne Street, Warrington*, for Large Gas Cooking Stove with Boiler. LEICESTER, 1885.
Fletcher, Thomas, *Thynne Street, Warrington*, for Horizontal Spiral Lavatory Heater. LEICESTER, 1885.
Fraser Bros., *Commercial Road, E.*, for Portable Disinfecting Apparatus. CROYDON, 1879.
Galbraith, T., *Crawford Square, Londonderry*, for Hot-Air Bath. LEAMINGTON, 1877.
Gandy, Maurice, *Liverpool*, for Cotton Machine Belting. DUBLIN, 1884.
General Gas Heating and Lighting Co., 66, *St. Paul Street, N.*, for Large Gas Cooking Stove with Boiler. LEICESTER, 1885.
" " Heating and Lighting Co., 66, *St. Paul Street, N.*, for Fibre Asbestos Open Gas Fire. LEICESTER, 1885.
Greenall, J., *Manchester*, for Steam Washer. LEICESTER, 1885.
Hall, John & Co., *Stourbridge*, for Fire-Clay Enamelled Bath. GLASGOW, 1883.
Hamilton & Co., *Leadenhall Street, E.C.*, for Prismoidal Pavement and Floor Lights. CROYDON, 1879.
Hancock, F. & C., *Dudley, Worcester*, for Machine for Washing and Cooling Butter. LEAMINGTON, 1877. *STAFFORD, 1878.
" for Machines for Domestic use. GLASGOW, 1883. *LEICESTER, 1885.

Haresceugh, B. B. & Co., *Bentinck Street, Leeds*, for Excreta Pail (oak) with Spring Lid. LEAMINGTON, 1877. *STAFFORD, 1878.

Harris, G. H., *Bristol Street, Birmingham*, for Economical Cooking Range. LEAMINGTON, 1877. *STAFFORD, 1878.

Hassall & Singleton, *Birmingham*, for Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas. STAFFORD, 1878.

Hayward, Tyler & Co., *London*, for Full-flush Valveless Closet. NEWCASTLE, 1882.

Heap, R. R., *Manchester*, for Dry Earth or Ashes Closet. GLASGOW, 1883. DUBLIN, 1884.

Hilliard, W. B., & Sons, *Glasgow*, for Hospital and Sick Room Appliances. GLASGOW, 1883.

Humber & Co., *Nottingham*, for their Exhibit of Bicycles and Tricycles. LEICESTER, 1885.

Hunt, Nathan, *Bristol*, for Auto-Pneumatic Ventilation. EXETER, 1880.

Jeyes' Sanitary Compounds Co., *London*, for Jeyes' Perfect Purifier. LEICESTER, 1885.

Johnson, W. F., *Leicester*, for Ornamental Domestic Appliances. LEICESTER, 1885.

Keith, J., *London and Edinburgh*, for Challenge Hot-water Boiler. GLASGOW, 1883.

Lascelles, W. H., *Bunhill Row, E.C.*, for Concrete Bath in one piece. CROYDON, 1879. *EXETER, 1880.

Le Grand & Sutcliffe, *Bunhill Row, E.C.*, for Improvements in Well Sinking Apparatus. LEAMINGTON, 1877. *CROYDON, 1879.

Leggott, W. & R., *Bradford*, for Opener for Fanlights and Skylights. LEICESTER, 1885.

Leoni, S., & Co., *Strand*, for Apparatus for Cooking by Gas. STAFFORD, 1878.

Lyon, J. W., *London*, for Steam Disinfector. LEICESTER, 1885.

Mackey, Mackey & Co., *London*, for Chemical Substances used for Disinfection. DUBLIN, 1884.

Maguire & Son, *Dublin*, for their Exhibit of Sanitary and Domestic Appliances. DUBLIN, 1884.

" " *Dublin*, for Wilcocks' Automatic Flushing Closet. DUBLIN, 1884.

Maignen, P. A., 20 & 23, *Great Tower Street, E.C.*, for Filtre Rapide. CROYDON, 1879. *EXETER, 1880. *GLASGOW, 1883. *DUBLIN, 1884. *LEICESTER, 1885.

Manlove, Alliott, Fryer & Co., *Nottingham*, for Fryer's Destructor, Fryer's Carbonizer, and Firman's Dessicating and Rendering Apparatus. NEWCASTLE, 1882.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner. NEWCASTLE, 1882.

Meyer, H. C., *New York*, Sanitary Engineer of New York, Newspaper. GLASGOW, 1883.

Moore, J., *St. James' Walk, Clerkenwell, E.C.*, for Glass Louvre Ventilators. EXETER, 1880.

Morris, Little & Co., *Doncaster*, for Little's Soluble Phenyle. STAFFORD, 1878.

Morrison, W. B., *Glasgow*, for Wedgwood Ornamental Tiles. GLASGOW, 1883.

Moser, L., *Southampton*, for Dry Closet, suitable for Ashes or Disinfecting Powder. EXETER, 1880.

Moule's Patent Earth Closet Company, *5a, Garrick Street, W.C.*, for Earth Closets. STAFFORD, 1878. *CROYDON, 1879. *LEICESTER, 1885.

Musgrave & Co., *Belfast*, for Slow Combustion Stoves. DUBLIN, 1884.

Orr, J. B., & Co., *Charlton, London*, for Leadless "Charlton White" Paint and Dryers. GLASGOW, 1883.

Parker, J., *Woodstock, Oxford*, for Dry Earth Closet. LEAMINGTON, 1877.

Pim Bros., *Dublin*, for their Exhibit of Furniture. DUBLIN, 1884.

Pocock, Bros., *Southwark Bridge Road*, for "Universal" Invalid Tubular Water and Air Bed. STAFFORD, 1878. *CROYDON, 1879.

Pritchett,, G. E., 20, *Spring Gardens, S.W.*, for Economic Hollow Flooring. STAFFORD, 1878. *CROYDON, 1879.

Purdy, W., *Eastwood, Notts.*, for Miners' Safety Lamp. LEICESTER, 1885.

Read, Jefferson, *Birmingham*, for Arcanum Process of Silver Plating Steel. CROYDON, 1879.

Richardson, J., & Co., *Leicester*, for their Exhibit of Antiseptic Preparations. LEICESTER, 1885.

Roberts, C. G., *Haslemere, Surrey*, for Rain-water Separator. NEWCASTLE, 1882. *GLASGOW, 1883.

Ross, J. A. G., *Newcastle-upon-Tyne*, for Silicate Cotton (Slag-wool). NEWCASTLE, 1882.

Rothwell, W., *Bolton*, for Flat Web Knitting Machine, and Rothwell Knitting Machines. DUBLIN, 1884.

Sanitary Appliance Company, *Salford*, for Portable Cinder Sifting Ash Closet, with Soil Pail. STAFFORD, 1878. *CROYDON, 1879. *LEICESTER, 1885.

Sanitary & Economic Supply Association, *Gloucester*, for Dr. Bond's Euthermic Gas Stove. EXETER, 1880.

Sanitary & Highway Appliance Co., *Sheffield*, for Roberts's Street Orderly Bin. LEICESTER, 1885.

Sanitary & Highway Appliance Co., *Sheffield*, for Roberts's Sand-distributor for 2-horse Tram-track. LEICESTER, 1885.

Sanitas Company (Limited), *London*, for Sanitas Oil. NEWCASTLE, 1882.

Scottish Asbestos Co., *Glasgow*, for Scottish Asbestos. GLASGOW, 1883.

Shanks & Co., *Barrhead, N.B.*, for Siphon-action Water Waste Preventer. DUBLIN, 1884.

Shaw, A., & Son, *Glasgow*, for "Sine quâ non" Open and Close Fire Range. GLASGOW, 1883.

Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquids. STAFFORD, 1878.

Sinclair, G., *Leith*, for Mechanical Stoker. GLASGOW, 1883.
Sinclair, J., *Leadenhall Street, E.C.*, for Tyndall's Smoke Respirator. CROYDON, 1879.
Singer Manufacturing Company, *London*, for Friction Driving Attachment for Sewing Machines. GLASGOW, 1883.
Smallman, John L., *Dublin*, for Stott's Mercury Gas Governor. *DUBLIN, 1884.
Smith, E., & Co., *Coalville*, for Embossed Tiles. LEICESTER, 1885.
Société Française D'Hygiène, *Paris*, for Chemical Preparations and Apparatus. LEAMINGTON, 1877.
" " *Paris*, for Books on Hygiène. NEWCASTLE, 1882.
Spongy Iron Water Purifying Company, *Oxford Street, W.C.*, for Bischof's Spongy Iron Filter. LEAMINGTON, 1877.
Stewart, J., Sen., *Glasgow*, for Stoneware Disconnecting Traps. GLASGOW, 1883.
" " *Glasgow*, for Stoneware Pipes with Stanford's Joint. *GLASGOW, 1883.
Stott, James, & Co., *Oldham*, for Mercury Gas Governor. NEWCASTLE, 1882. *LEICESTER, 1885.
Trott, H., *Battersea, London*, for the "Household" Closet. LEICESTER, 1885.
Turk, R. J., *Kingston-on-Thames*, for Cruising Canoe. LEICESTER, 1885.
Tylor & Sons, *Newgate Street, E.C.*, for Flushing Rim Lavatory Basin and Apparatus. EXETER, 1880.
Verity, E. & J. M., *Leeds*, for Crabtree's Kitchen Range. LEICESTER, 1885.
Victoria Stone Co., *London*, for Victoria Artificial Stone-Paving. LEICESTER, 1885.
Vipan & Headly, *London*, for their Exhibit of Dairy Appliances. LEICESTER, 1885.
Walker, Chas. W., *Wandsworth Common*, for Acid Pump and Syphon. CROYDON, 1879.
Walker, Turnbull & Co., *Falkirk*, for Artizan Cooking Range. GLASGOW, 1883.
Ward, O. D., *London*, for Household Water Closet. NEWCASTLE, 1882.
" " for Bean's Direct Acting Valveless Waste Preventer. *NEWCASTLE, 1882.
Webb, H. Chalk, *Worcester*, for Colouring Patterns through the Substance of Wood. EXETER, 1880.
Wenham, W. P., *Church Street, Croydon*, for Improved Open or Close Range Kitchener. CROYDON, 1879.
Wenham's Patent Gas Lamp Co., *London*, for Wenham Ventilating Gas Lamp. DUBLIN, 1884.
Wentworth, F., & Co., *London*, for "Kredemnon" Life-saving Garments. GLASGOW, 1883.
Whyte & Bradford, *Bowness*, for Cooking Range with Revolving Fire for the Prevention of Smoke. GLASGOW, 1883.
Wilkinson, W. B. & Co., *Newcastle-upon-Tyne*, for Damp-proof Concrete Pavement. NEWCASTLE, 1882.

Willacy, R., *Preston*, for Sand-distributor for Roads.
LEICESTER, 1885.

Willcocks & Co., *Burmantofts, Leeds*, for Silica Glazed and Enamelled Fire Clay Bricks and Fäience. CROYDON, 1879.

Wilson Engineering Company, *Holborn, W.C.*, for Wilson Portable Close Cooking Range. EXETER, 1880.

" " for Improved Wilson Range. with Steel Boiler and non-conducting Jacketing.
NEWCASTLE, 1882. *GLASGOW, 1883. *DUBLIN, 1884.

Wippell Bros. & Row, 231, *High Street, Exeter*, for Moule's Earth Closet. *EXETER, 1880.

Woollams & Co., *High Street, Marylebone*, for Paper Hangings free from Arsenic. CROYDON, 1879. *NEWCASTLE, 1882.

" " for Non-Arsenical Pigments and Paper Hangings. *GLASGOW, 1883.

Woodhouse & Rawson, *London*, for their Incandescent Electric Lamp.
LEICESTER, 1885.

Wright, J., & Co., *Birmingham*, for "Eureka" Gas Cooking Stove.
DUBLIN, 1884.

Wright, J., & Co., *Broad Street, Birmingham*, for "Eureka" Artisan Gas Cooking Stove. LEICESTER, 1885.

Wright, J., & Co., *Broad Street, Birmingham*, For Lump Asbestos Open Gas Fire. LEICESTER, 1885.

ALPHABETICAL LIST OF CERTIFICATES AWARDED AT THE EXHIBITIONS.

Adams, R., 7, *Great Dover Street, S.E.*, for Adjustable Shoe, and Regulating Spring Hinge for Swinging Doors. CROYDON, 1879.

" " for Fanlight Openers and Casement Fasteners. CROYDON, 1879.

" " for the Norton Door Spring DUBLIN, 1884.

" " for Adjustable Pivot for Fanlights. DUBLIN, 1884.

" " for "Victor" Spring Hinge. LEICESTER, 1885.

" " for Side Gussets for Fanlights. LEICESTER, 1885.

Adams & Co., *York*, for Potts' Edinburgh Sewer Trap. LEICESTER, 1885.

" " for Improved Shape of Trough for Water Closets. LEICESTER, 1885.

Allen, Thomas, *St. Augustine's Parade, Bristol*, for Metallic Tubular Bedsteads and Invalid Bedrests. STAFFORD, 1878.

Angell, A. T., *London*, for Air-tight Man-hole Door. NEWCASTLE, 1882. GLASGOW, 1883.

Antiseptic Apparatus Manufacturing Co. (Limited), for Red Cross Yellow Fluid. NEWCASTLE, 1882.

Arden Hill & Co., *Birmingham*, for Solid Flame Boiling Stove. NEWCASTLE, 1882.

" " for Gas Cooking Stove, lined with White Tiles. DUBLIN, 1884.

" " for Lump Asbestos Open Gas Fire. LEICESTER, 1885.

Ashwell, Frank, *Leicester*, for Steam Kettle with specially arranged Tap for drawing Boiling Water. LEICESTER, 1885.

Baird, W., *Dublin*, for Butler's Sink, lined with Block Tin. DUBLIN, 1884.

" " for White Enamelled Fireclay Sinks. DUBLIN, 1884.

" " for Bath, with Shower Douche and Spray Fittings combined. DUBLIN, 1884.

" " for Lavatory, with Shampooing Apparatus. DUBLIN, 1884.

" " for Hydraulic Ram. DUBLIN, 1884.

" " for Improved Horizontal-Pull Fittings for Baths and Lavatories. DUBLIN, 1884.

Baird, Thompson & Co., *Glasgow*, for Watts's Asphyxiator for Testing Drains with Smoke. DUBLIN, 1884.
Ball, Ancell, *Spalding*, for Folding Invalid Bed. CROYDON, 1879.
Bartrum, Harvey & Co., *London*, for Ventilatorium Waterproof Garments. STAFFORD, 1878.
Beard, Dent & Hellyer, 21, *Newcastle Street, W.C.*, for Artisan Closet. CROYDON, 1879.
" " for Ventilating Drain Syphon. CROYDON, 1879.
Bensdorp & Co., *London*, for Soluble Dutch Cocoa. DUBLIN, 1884.
Bethell, T. P., *Liverpool*, for the "Unique" Folding Box. LEICESTER, 1885.
Beveridge & Co., *Glasgow*, for Pickles and Sauces. GLASGOW, 1883.
Billington Bros., *Liverpool*, for Spring Mattresses. GLASGOW, 1883.
" " for Portable Bed, with Liverpool Spring Mattress. DUBLIN, 1884.
Binnie, J., *Gartcosh, Glasgow*, for Salt-glazed Fire-clay Sewer Pipes. GLASGOW, 1883.
Binns & Armitage, *Derby*, for Miller's Pride Oatmeal. LEICESTER, 1885.
Bird, Peter Hinckes, 1, *Norfolk Square, N.W.*, for Method of Costless Ventilation. CROYDON, 1879.
" " for Large Legible Spirit Thermometer. EXETER, 1880.
Borough Leather Warehouse Company, *London*, for Crocodile Hide Leather. GLASGOW, 1883.
Bourtreehill Coal Co., *Dreghorn, Ayrshire*, for Stoneware Drain Pipes. DUBLIN, 1884.
" " for White Enamelled Fireclay Sinks. DUBLIN, 1884.
" " for White Enamelled Sinks and Wash Tubs. LEICESTER, 1885.
" " for White Enamelled Fireclay Laundry Trough. DUBLIN, 1884.
" " for White Enamelled Bricks. DUBLIN, 1884.
Bowden, William, *London*, for Automatic Chariot for Children. NEWCASTLE, 1882.
" " for Olive Oil Soap. LEICESTER, 1885.
Boyd, S., *Dublin*, for Soaps. DUBLIN, 1884.
" " for Chemicals used in Disinfection. DUBLIN, 1884.
Bradford, T., & Co., *Salford*, for Black Diamond Boot & Shoe Cleaning Machine. LEICESTER, 1885.
Bradbury & Co., *Oldham*, for Revolving Shuttle for Sewing Machines. GLASGOW, 1883.
Brady & Martin, *Newcastle-upon-Tyne*, for Central Tube Water Mattress. NEWCASTLE, 1882.
" " for Instruments used by Medical Officers of Health. NEWCASTLE, 1882.
Braithwaite & Co., *Leeds*, for Syphon for Water Closet Cisterns. CROYDON, 1879.

Branksea Island Pottery Company, Limited, *Poole, Dorset*, for Stoneware Pipes. EXETER, 1880.

Bray & Co., *Blackman Lane, Leeds*, for Improved Gas Burners. CROYDON, 1879.

British and Foreign Mineral Water Company, *Glasgow*, for Potash, Soda and Seltzer Waters, and Lemonade. NEWCASTLE, 1882.

British Sanitary Company, *Glasgow*, for Self-Acting Earth Closet. EXETER, 1880.

Broad & Co., *Paddington*, for White Glazed Facing Bricks. LEICESTER, 1885.

" " for White Enamelled Straight and Curved Channels for Inspection Chambers to Drains. LEICESTER, 1885.

" " for White Enamelled Fire-clay Gullies. LEICESTER, 1885.

Brock, W., & Co., 177, *Fore Street, Exeter*, for Bed Rest with Moveable Arms. EXETER, 1880.

" " for "Nonsuch" Adjustable Chair. EXETER, 1880.

Buchan, W. P., *Glasgow*, for Improved Drain Pipe, with Access Cover. NEWCASTLE, 1882.

" " for Disconnecting Drain Trap. NEWCASTLE, 1882. GLASGOW, 1883.

" " for Grease Trap for Kitchen Sinks. GLASGOW, 1883.

Burroughs, Wellcome & Co., *London*, for Absorbent Cotton and Antiseptic Sponges. DUBLIN, 1884.

" " for Kepler's Extract of Malt and combinations of it with Pepsine, Chocolate, and Cod Liver Oil. DUBLIN, 1884.

Bussey & Co., *Museum Works, Peckham, S.E.*, for Patent Spring Mattress. CROYDON, 1879.

Cadle, C., *Dublin*, for Silicate Cotton Composition for covering Steam Pipes. DUBLIN, 1884.

Calvert, F. C., & Co., *Bradford*, for Improved Vaporiser for Disinfecting. EXETER, 1880.

" " for 50% Carbolic Disinfecting Powder. GLASGOW, 1883.

" " for Carbolic Soaps. DUBLIN, 1884. LEICESTER, 1885.

" " for Soluble Cresol. DUBLIN, 1884.

" " for Tooth Soap. LEICESTER, 1885.

Candy & Co., *Newton Abbot*, for Granite Vitrified Bricks and Paving. EXETER, 1880.

Capper, Son & Co., *London*, for Brian Jones's Joint for connecting Closet with Soil-pipe. NEWCASTLE, 1882.

Carron Company, *Falkirk, N.B.*, for Combined Close Fire and Gas Cooking Range. GLASGOW, 1883.

Carson, W., & Sons, *Dublin*, for their exhibit of Tricycles.
DUBLIN, 1884.
" " for Willesden Waterproof Paper and Canvas.
DUBLIN, 1884.
" " for Tortoise Slow Combustion Stoves.
DUBLIN, 1884.
Carter & Co., *Old Refinery, Bristol*, for Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic.
EXETER, 1880.
Chorlton & Dugdale, *Manchester*, for "Sun-light Stove." EXETER, 1880.
" " for "Invalids'" Adjustable Bed.
EXETER, 1880.
" " for "Excelsior" Ship's Berth.
GLASGOW, 1883.
" " for Hospital Bed, fitted with Raising Appliances. DUBLIN, 1884.
" " for Pitch Pine Lath Mattress.
DUBLIN, 1884.
" " for Hospital Bed, with New Spring Mattress.
DUBLIN, 1884.
Clarke, E., & Co., *Battersea*, for "Optimus" Coffee Extract.
DUBLIN, 1884. LEICESTER, 1885.
Clarke, F. W., Portable Gas Apparatus Company (Limited), *Great Queen Street, W.C.*, for Portable Gas Apparatus for Manufacturing Gas from Gasoline. CROYDON, 1879.
Colman & Glendenning, *Norwich*, for School Desks with Shifting Seats. STAFFORD, 1878.
" " for Automaton Seat for Drapers.
EXETER, 1880.
Coltman, T., *Leicester*, for Conical Knitting Machine. LEICESTER, 1885.
Compostella Fire-Light Company, *Fenchurch Street, E.C.*, for Compostella Fire Lights for Lighting Fires. STAFFORD, 1878.
Constantine, T. J., *Fleet Street, E.C.*, for Devonshire Cooking Range.
EXETER, 1880.
Cooper, H. W., & Co., *London*, for Glass Revolving and Sliding Ventilators. GLASGOW, 1883.
Cordingley, T., & Sons, *Bradford*, for Granite Concrete Pavement.
DUBLIN, 1884.
Craig, J. & M., *Kilmarnock*, for Buchan's Trap. EXETER, 1880.
" " for Maguire's Cradle Joint for Drain Pipes.
NEWCASTLE, 1882.
" " for Buchan's Drain Trap and Drain Pipes, with Access Cover. NEWCASTLE, 1882.
" " for White Enamelled Fire-Clay Sinks.
NEWCASTLE, 1882. GLASGOW, 1883.
" " for Stoneware Disconnecting Traps.
GLASGOW, 1883.
" " for White Enamelled Bricks. DUBLIN, 1884.
" " for Buchan's Disconnecting Trap.
DUBLIN, 1884.

Cregeen, H. S., *Bromley*, for Air Inlet Head for Drain Ventilation. NEWCASTLE, 1882.

Croft Stone Quarry & Brick Co., *Croft, Leicestershire*, for the Croft Artificial Stone Paving. LEICESTER, 1885.

Dales, J. T., *London*, for Porpoise Oil Dubbin. LEICESTER, 1885.

Davis, Joseph & Co., *London*, for New Oven Pyrometer. NEWCASTLE, 1882.

Dinning & Cooke, *Newcastle-upon-Tyne*, for Cast Iron Channels for Stable Drainage. NEWCASTLE, 1882.

" " for George's Calorigen. NEWCASTLE, 1882.

" " for Jennings's Universal Shampooing Apparatus. NEWCASTLE, 1882.

" " for Grates, Mantel-pieces, and Over-mantels. NEWCASTLE, 1882.

Dockrell, Thomas, Sons & Co., *Dublin*, for Cheap Artistic Non-arsenical Washable Wall Paper. DUBLIN, 1884.

Doulton & Co., *Lambeth, London*, for Decorative Tiles for Covering Walls and Floors. CROYDON, 1879.

" " for Disconnecting Gully, with back and side Entrances and iron grating. CROYDON, 1879.

" " for Economical Flush-Out Closet. EXETER, 1880.

" " for Anti-Percussion High-pressure Bib Valves. NEWCASTLE, 1882.

" " for Bath Locking Valves, for preventing waste of water. NEWCASTLE, 1882. DUBLIN, 1884.

" " for Latham's Flap Valve. NEWCASTLE, 1882.

" " for Joint for Drain-pipes. NEWCASTLE, 1882.

" " for Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating. NEWCASTLE, 1882.

" " for "Lambeth" Flush-out Closet. NEWCASTLE, 1882. GLASGOW, 1883.

" " for Tip-up Lavatory Basin. NEWCASTLE, 1882.

" " for "Lambeth" Trough Closet with Automatic Flush Tank. GLASGOW, 1883.

" " for Silicon Tread for Steps. GLASGOW, 1883. DUBLIN, 1884. LEICESTER, 1885.

" " for Glazed Ware Mantelpiece, with Slow Combustion Grate. DUBLIN, 1884.

" " for Vacuum Flushing Cistern for Closet, with Seat-action Arrangement. DUBLIN, 1884.

" " for cheap Glazed Stoneware Sinks. DUBLIN, 1884.

" " for "Lambeth" Combination Water-closet. DUBLIN, 1884.

" " for Enamelled Ware Open Channels for Manholes. DUBLIN, 1884.

Doulton & Co., *Lambeth*, for Manhole for Drains, with connections complete. DUBLIN, 1884.
" " for London-made Stoneware Pipes. DUBLIN, 1884.
" " for Economical Combination Closet in two pieces. LEICESTER, 1885.
Dublin & Wicklow Manure Co., for Alum Cake. DUBLIN, 1884.
Durand Claye, A., *Paris*, for Drawings and Books Relating to Disposal of Sewage in Paris. GLASGOW, 1883.
Edmunds, J., *London*, for Currie Powders. NEWCASTLE, 1882.
Edwards, J. C., *Trefynant, Ruabon*, for Dean's External Drain Traps, with moveable receptacle. CROYDON, 1879.
Elliott, Edminson & Olney, *Manchester*, for Cold Metal Double Cone Mechanical Lead Pipe Joints. LEICESTER, 1885.
Ellis, J. J., *Ellistown Collieries*, for Gordon's Disconnecting Trap. LEICESTER, 1885.
Ellison, J. E., *Leeds*, for "Radiator" Ventilator, with Screw Action. GLASGOW, 1883. DUBLIN, 1884.
Elvery, J. W., & Co., *Dublin*, for the Leander Life Belt. DUBLIN, 1884.
" " for Gentlemen's Ventilated Waterproof Overcoats. DUBLIN, 1884.
Evans & Co., *Wrexham*, for Zoedone. (Patentee, David Johnson, F.C.S.) CROYDON, 1879.
Fell, J., & Co., *Wolverhampton*, for Clark's Anti-splash Tip-up Lavatory Basin. NEWCASTLE, 1882.
" " for Smith's Cast Lead Syphon Traps. NEWCASTLE, 1882.
" " for Water-taps. NEWCASTLE, 1882.
Fergusson & Starkey, *Leicester*, for "Shanks's" Porcelain Lavatory Fittings. LEICESTER, 1885.
" " for Shanks's "Eureka" Spray and Plunge Bath. LEICESTER, 1885.
" " for "Unbreakable" Fire-clay Lavatory Basins for Schools, &c. LEICESTER, 1885.
Finch & Co., 181, *High Holborn, W.C.*, for Large Way Waste Plug, with Protective Cover. CROYDON, 1879.
Fleming, W., *Dublin*, for the Combination Bedstead. DUBLIN, 1884.
Fletcher Bros., *Dublin*, for Exhibit of Tricycles. DUBLIN, 1884.
Fletcher, Thomas, *Warrington*, for Washing Machine, Heated by Gas. LEICESTER, 1885.
Forrest, William, *Newcastle-upon-Tyne*, for The Albo-Carbon Light. NEWCASTLE, 1882.
Foster & Pearson, *Nottingham*, for Morris's Cast Iron Gulley, with Moveable Dip Pipe. LEICESTER, 1885.
Fry, J. S., & Sons, *Union Street, Bristol*, for Cocoa Extract and Preparations of Chocolate. EXETER, 1880.
Gandy, M., *Liverpool*, for Cotton Machine Belting. GLASGOW, 1883.
" " for Steil's Fastener for Machine Belting. GLASGOW, 1883.

Gardner, A., & Son, *Glasgow*, for Spring Mattress. GLASGOW, 1883.
" " for Parquet Flooring. GLASGOW, 1883.
" " for Method of Rendering Timber Non-inflammable. GLASGOW, 1883.
Garton & King, *Exeter*, for Vowel E. Bradford's Family Washing Machine. EXETER, 1880.
General Gas Heating and Lighting Co., 66, *St. Paul Street, N.*, for Artisan Gas Cooking Stove. LEICESTER, 1885.
Gent, J. T., & Co., *Leicester*, for their Exhibit of Electric Bells. LEICESTER, 1885.
Gilbert, E. & A. E., *Broughty Ferry, Forfarshire*, for Improved Seat for Water Closets. GLASGOW, 1883.
Gillow & Co., *Oxford Street, W.*, for Lavatory. STAFFORD, 1878.
Goode & Co., *Loughborough*, for "Invicta" Flushing Cistern. LEICESTER, 1885.
" " for Double Valves for Flow and Return in Hot-water Circulation. LEICESTER, 1885.
Graham, W., *Dublin*, for Ventilated Hats. DUBLIN, 1884.
Groom & Co., *London*, for Bower's Potato Steamer. DUBLIN, 1884.
" " for Self-indicating Tea or Coffee Infuser. DUBLIN, 1884.
" " for Well and Dry-Platform Sponge Bath. LEICESTER, 1885.
Grosvenor, F., *Glasgow*, for Stoneware Churns. GLASGOW, 1883.
Groves, E. K., *Bristol*, for Self-acting Sick Bed. GLASGOW, 1883.
Gulliver & Co., *Aylesbury*, for Lemonade, Lime Juice, and Ginger Ale. CROYDON, 1879.
Hamilton, W., *Brighton*, for Invalid "Grasshopper" Couch. STAFFORD, 1878. NEWCASTLE, 1882.
Hammond & Hussey, *High Street, Croydon*, for Hornibrook's Catchment Grating for Steep Gradients. CROYDON, 1879.
Hancock, F. & C., *Dudley, Worcester*, for New Propellor Churn. EXETER, 1880.
" " for Dough Kneading Machine. EXETER, 1880.
" " for Machine for Washing and Peeling Potatoes. NEWCASTLE, 1882.
Harriman, W., & Co., *Blaydon-upon-Tyne*, for Fowler's Water-closet. NEWCASTLE, 1882.
Harrison, F. J., & Co., *Leicester*, for Hydroleine Soap Powder. LEICESTER, 1885.
Harrison Patent Knitting Machine Co., *Manchester*, for Knitting Machines. DUBLIN, 1884.
Harrisson, T. Harnett, *Liverpool*, for Iron Basket Sewage-strainer. GLASGOW, 1883.
" " for Improved Method of Connecting Lead Pipes with Stoneware Pipes. GLASGOW, 1883.
Hayward, Tyler & Co., *London*, for Shower and Douche Bracket. NEWCASTLE, 1882.

Headley & Sons, *Cambridge*, for Hose Reel. CROYDON, 1879.
Henderson, Osbert, *Glasgow*, for Albo-Carbon Light. GLASGOW, 1883.
" " for Pendulous Food Warmers. GLASGOW, 1883.
Heron, T., *Manchester*, for Duplex Burner. NEWCASTLE, 1882.
Hildesheim, J., *Glasgow*, for Dicks' L'Extincteur. GLASGOW, 1883.
Hill & Hey, *Halifax*, for Double Current Ventilators. GLASGOW, 1883.
Hilliard, W. B., & Sons, *Glasgow*, for Isolating Curtain. GLASGOW, 1883.
" " for Burn and Wound Boxes. GLASGOW, 1883.
Hilton, W. H., *Leamington*, for various Inventions for Promoting Domestic Economy. STAFFORD, 1878.
Hotblack, J., & Son, *Norwich*, for an Improved Shape of Boot. DUBLIN, 1884.
Hutchinson, A., & Co., *Great Winchester Street, E.C.*, for India Rubber Gas Tubing. EXETER, 1880.
Humpherson, F., *London*, for "Beaufort" Flush-down Closet. LEICESTER, 1885.
" " for Siphon Flushing Cistern. LEICESTER, 1885.
" " for Clip Pipe Joint. LEICESTER, 1885.
Hydes & Wigfull, *Sheffield*, for Tortoise Slow Combustion Stoves. GLASGOW, 1883.
" " for Tortoise Laundry Stove. GLASGOW, 1883.
Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham*, for "Eagle" Sanitary Trap, for superseding Bell Traps. CROYDON, 1879.
Indian Tea Company, *Glasgow*, for Indian Tea. GLASGOW, 1883.
Irvine & Co., *Gateshead*, for Mustard. NEWCASTLE, 1882. GLASGOW, 1883.
Jennings, G., *Stangate, London*, for "Artisans' Dwellings Sink." CROYDON, 1879.
" " for Universal Shampooing Apparatus. CROYDON, 1879.
Jennings, T., *Lambeth*, for Hospital Flooring. LEICESTER, 1885.
Jewsbury & Brown, *Manchester*, for Seltzer Water. STAFFORD, 1878.
Jeyes' Sanitary Compounds Company, *Cannon Street, E.C.*, for Jeyes' Perfect Purifier. CROYDON, 1879. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.
" " for Jeyes' Household Disinfecting Soaps. LEICESTER, 1885.
Johnson, W. F., *Leicester*, for his Exhibit of Repoussé and other Brass Work. LEICESTER, 1885.
" " for Galvanized Iron Dust-Bin. LEICESTER, 1885.
Kenworthy, E. N., & Co., *Oldham*, for Paragon Washing Machine with Canadian Washer. LEICESTER, 1885.
Kirk, E. G., *Huddersfield*, for Night Soil Receptacle with Spring Lid. LEICESTER, 1885.
Kirsop & Co., *Newcastle-upon-Tyne*, for Paragon Washing Machine, with Canadian Washer. NEWCASTLE, 1882.

Kite, C., & Co., *London*, for Outlet Ventilator. NEWCASTLE, 1882.
" " for Noiseless Chimney Breast Outlet Ventilator.
" " for Wall Inlet Ventilator.
GLASGOW, 1883. DUBLIN, 1884.
" " for Telescoped Wall Inlet Ventilator.
LEICESTER, 1885.
Knell, U., 77, *Fore Street, E.C.*, for "Imperial" Ventilating Window.
CROYDON, 1879.
Ladies' Sanitary Association, *Berners Street, W.*, for Publications.
STAFFORD, 1878.
Larmouth, Thomas, & Co., *Salford*, for Dual Desk, with Separate Gangway Seat. STAFFORD, 1878.
Leggott, W. & R., *Bradford*, for Opener for Fanlights and Skylights.
GLASGOW, 1883. DUBLIN, 1884.
Leicester Ambulance Corps, for Hand Ambulance. LEICESTER, 1885.
Leoni, S., & Co., *Strand, W.C.*, for "Rheometer" Street Lamp Regulator. STAFFORD, 1878.
Lewis, Mrs. A., *Manchester*, for Tin Cooking Utensils. CROYDON, 1879.
London Necropolis Company, *Strand, W.C.*, for "Earth to Earth" Coffins. STAFFORD, 1878.
McCallum, J. B., *Stafford*, for Improved Non-Absorbent Tub or Pail Van. EXETER, 1880.
McGeoch, W., & Co., *Glasgow*, for Dow's Close and Open Fire Cooking Range. GLASGOW, 1883.
Maguire & Son, *Dublin*, for Dr. Scott's Disinfecting Apparatus.
NEWCASTLE, 1882. DUBLIN, 1884.
" " for White Enamelled Fireclay Sinks.
DUBLIN, 1884.
" " for Cast-iron Drain Pipes, coated with Angus Smith's Preparation. DUBLIN, 1884.
" " for Marsden Tiling for Wall Decoration.
DUBLIN, 1884.
" " for New Laundry Stove and Copper Boiler.
DUBLIN, 1884.
" " for Wilcocks' Automatic Flushing Closet.
DUBLIN, 1884.
Maignen, P. A., 20 & 23, *Great Tower Street, E.C.*, for "Bijou" Filtre Rapide. EXETER, 1880.
" " for Improved Filtre Rapide. NEWCASTLE. 1882.
" " for Anti-Calcaire Powders for Softening Water.
GLASGOW, 1883.
" " for the Soldier's Filter. LEICESTER, 1885.
" " for Field Hospital Filter. LEICESTER, 1885.
Maling, C. T., *Newcastle-upon-Tyne*, for Sanitary Earthenware.
NEWCASTLE, 1882.
" " for Lavatory Basin with Flushing Rim.
NEWCASTLE, 1882.
Manlove, Alliott, Fryer & Co., *Nottingham*, for Lyon's Disinfector.
NEWCASTLE, 1882.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Hink's Duplex Lamp, with Extinguisher. NEWCASTLE, 1882.
" " for Steam Heating Apparatus, combining heating and ventilating. NEWCASTLE, 1882.
Midland Educational Co., *Leicester*, for the "Reliance" Lift-up Desk. LEICESTER, 1885.
Mitchell, James, *Newcastle-upon-Tyne*, for Mitchell's Steam Washer. NEWCASTLE, 1882.
Morgan, J., *Dublin*, for Pith Helmet. DUBLIN, 1884.
Morrison, W. B., *Glasgow*, for "National" Water Closet. GLASGOW, 1883.
Murton, H. A., *Newcastle-upon-Tyne*, for Indiarubber Vessels for hospital use. NEWCASTLE, 1882.
Nailsworth Foundry Company, *Bristol*, for Morgan's Stench Exhaust. NEWCASTLE, 1882.
Newry Mineral Water Company (Limited), *Liverpool*, for Ginger Ale and Lemonade. CROYDON, 1879.
Nightingale & Co., *Great Grimsby*, for Method of Wood Block Flooring. LEICESTER, 1885.
Oates & Green, *Horley Green Fire Clay Works, Halifax*, for Drain-cleaning Rods, and Stoneware Horse Manger. STAFFORD, 1878.
Onions, J. C. (Limited), *Birmingham*, for Moser's Self-Acting Dry Closet. CROYDON, 1879.
Parker, J., *Woodstock*, for Dry Earth Commode without Separator. EXETER, 1880.
Parr, J., & Co., *Leicester*, for their Exhibit of Bicycles and Tricycles. LEICESTER, 1885.
Patent Porous Carbon Co., *London*, for Porous Carbon for Filtering Water. LEICESTER, 1885.
Patent Victoria Stone Company, *Kingsland Road, E.*, for Artificial Stone Tubes. CROYDON, 1879.
Pearson & Co., *Dublin*, for the Institution Bed with Woven-Wire Mattress. DUBLIN, 1884.
Pennycook Patent Glazing and Engineering Co., *Glasgow*, for the system of Glazing without Putty. GLASGOW, 1883.
DUBLIN, 1884.
Pim Bros., Limited, *Dublin*, for the Victoria Knitting Machine. DUBLIN, 1884.
" " for the Hinged Cot. DUBLIN, 1884.
Potts & Co., *Handsworth, Birmingham*, for Edinburgh Air-Chambered Sewer Trap. STAFFORD, 1878.
Pringle, R., M.D., *Blackheath*, for Working Model of Cattle Drinking Trough. LEICESTER, 1885.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Warming and Ventilating Appliances. STAFFORD, 1878.
" " for Thermometrical Instruments. STAFFORD, 1878.
" " for Barometrical and Thermometrical Instruments. CROYDON, 1879.
" " for Corrugated Iron Hot-Water Warming Appliances. EXETER, 1880.

Pritchett, E. G., for Improvements in Thermometrical and Barometrical Instruments. EXETER, 1880.
Ransome, S. E., & Co., 10, *Essex Street, W.C.*, for "Milwaukee" Glass Lantern or Hurricane Lantern. CROYDON, 1879.
Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Dean's Gully Trap. NEWCASTLE, 1882.
" " for Enamelled Fire Clay Bath. NEWCASTLE, 1882.
Ross, W., *Glasgow*, for Improved Paragon Valve. GLASGOW, 1883.
Ruffard & Co., *Fire-Clay Works, Stourbridge*, for Porcelain Baths, moulded and glazed in one piece. STAFFORD, 1878.
Salmon, Barnes & Co., *Ulverston*, for Revolving Shutters with Balance Weight Motion. EXETER, 1880.
Sanitary & Highway Appliance Co., *Sheffield*, for Roberts's Asphalte Cauldron. LEICESTER, 1885.
Scott, A. & R., *Glasgow*, for Midlothian Oat-flour. GLASGOW, 1883.
Scott, F. R., & Co., *Dublin*, for Solid Oak Parquet Flooring. DUBLIN, 1884.
" for exhibit of Furniture. DUBLIN, 1884.
Selig, Sonnenthal & Co. (Limited), *Lambeth Hill, Queen Victoria Street, E.C.*, for Safety Belt Shippers. CROYDON, 1879.
Shanks & Co., *Glasgow*, for Cast Iron Bath. GLASGOW, 1883. DUBLIN, 1884.
" for Porcelain Lavatories, with moveable caps for access to fittings. GLASGOW, 1883. DUBLIN, 1884.
" for "Eureka" Spray and Plunge Bath. GLASGOW, 1883.
Sharman, T., *Leicester*, for Heating Apparatus for Small Greenhouses. LEICESTER, 1885.
Sharp, C. H., & Co., *High Holborn, E.C.*, for Ornamental Inlet Ventilators. EXETER, 1880.
Sharp, Jones & Co., *Bourne Valley Pottery, Poole, Dorset*, for Rock Concrete Tubes. CROYDON, 1879.
Shone, Isaac, *Wrexham*, for Pneumatic Liquid Ejector. STAFFORD, 1878.
Short, Patrick, *Dublin*, for the Rhinoceros Hide "S" Boot. DUBLIN, 1884.
Silicated Carbon Filter Company, *Battersea*, for Silicated Carbon Double Chambered Table Filters. EXETER, 1880.
" " for Silicated Carbon Filtering Material. NEWCASTLE, 1882.
Sinclair, J., 104, *Leadenhall Street, E.C.*, for Chemical Fire Exterminator. CROYDON, 1879.
Skinner, G. H., 13, *North Street, Exeter*, for Seltzer, Soda and Potash Waters, and Orange Quinine Tonic. EXETER, 1880.
Smith, E., & Co., *Coalville*, for Red Building Bricks. LEICESTER, 1885.
" " for Photographic Embossed and Incised Tiles. LEICESTER, 1885.
Smith, Elder & Co., *London*, for Sanitary Publications. NEWCASTLE, 1882. GLASGOW, 1883. DUBLIN, 1884.

Smith, James, *Liverpool*, for Open Grate for consuming Smoke. NEWCASTLE, 1882.

Smith, J., & Sons, *Wolverhampton*, for Closed Sectional Sanitary Van. LEICESTER, 1885.

Snell, H. Saxon, *Southampton Buildings*, for Thermhydric Ventilating Hot-Water Open Fire Grate. STAFFORD, 1878.

Staynes & Sons, *Leicester*, for Boot and Shoe Uppers. LEICESTER, 1885.

Stephan, J. A., *Worcester*, for Carbonised Iron Stone Mound Filter for Water. EXETER, 1880.

Stephenson & Travis, *Liverpool*, for Stypium Absorbent Antiseptic Surgical Dressings. DUBLIN, 1884.

Stewart, J., Sen., *Glasgow*, for Disconnecting Chamber for House Drains, with open Stoneware Channels. GLASGOW, 1883.

Stidder & Co., 50, *Southwark Bridge Road, S.E.*, for Swivel, Lock Plug, and Overflow for Sink. CROYDON, 1879.

Stiff, James, & Sons, *Lambeth, London*, for Weaver's Ventilating Sewer Air Trap. STAFFORD, 1878. LEICESTER, 1885.

" " " for their Exhibit of Architectural Terra Cotta. LEICESTER, 1885.

Straker & Love, *Newcastle-upon-Tyne*, for Large Fire-clay Drain-pipes. NEWCASTLE, 1882.

Stretton, S., *Kidderminster*, for Folding Bier and Car for Simplifying Funerals. CROYDON, 1879.

Taylor & Co., *Driffield & London*, for "Simplex" Desk with Adjustable Foot Board. LEICESTER, 1885.

Thomasson & Key, *Worcester*, for Cup Grating for Sinks. NEWCASTLE, 1882.

Thorn & Co., *Stafford*, for Artificial Stone Filters, for Cleansing Rain Water for Domestic Use. STAFFORD, 1878.

Thornburn, William, *Borough Bridge*, for Tubular Calorifer for Greenhouses. NEWCASTLE, 1882.

Torrance, W. H., *Edinburgh*, for Rusks, Shortbread, and Oatcakes. LEICESTER, 1885.

Townsend & Co., *Newcastle-upon-Tyne*, for China Cups and other Vessels for Invalid use. NEWCASTLE, 1882.

Trott, H., *Battersea*, for Bib Valves for Hot and Cold Water. LEICESTER, 1885.

Twyford, T., *Hanley*, for Lavatory Basins. DUBLIN, 1884.

" " for Slop Sinks. DUBLIN, 1884.

" " India-Rubber Connection for Joining Lead and Earthenware Pipes. DUBLIN, 1884.

Tylor, J., & Sons, 2, *Newgate Street, E.C.*, for "Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box. EXETER, 1880.

" " for Improved Enamelled Iron Slop Sink, with Regulator Supply Valve. EXETER, 1880.

" " for Improved Full-Way Stop Valve. EXETER, 1880.

" " for "Waste Not" Regulator Valve. EXETER, 1880. NEWCASTLE, 1882.

Tylor, J., & Sons, for Hospital Slop Sink, with Waste-not Regulator Valve. NEWCASTLE, 1882.
" " for Bath Locking Valves for preventing waste of water. NEWCASTLE, 1882.
" " for Flushing-rim Lavatory Basin, with Quick Waste. NEWCASTLE, 1882.
" " for Flush-out Urinal Basin. NEWCASTLE, 1882.
" " for Joint for Lead Pipes. NEWCASTLE, 1882.
" " for Water-closets. NEWCASTLE, 1882.
Tyrrell, Brooke, *Dublin*, for exhibit of Furs. DUBLIN, 1884.
Vernon's Patent China and Glass Company, *London*, for Noiseless Ware. GLASGOW, 1883.
Vipan & Headly, *Leicester*, for Heavy Steel Railway Churn, with Malleable Top and Dust-proof Lid. LEICESTER, 1885.
" " for Danish Cream Separator. LEICESTER, 1885.
Walker, Turnbull & Co., *Falkirk*, for Simplex Cooking Range. GLASGOW, 1883.
Waller, Thomas, 47, *Fish Street Hill*, *E.C.*, for Cooking Stove with Warm-Air Chamber. CROYDON, 1879.
Walton, F., & Co., *London*, for "Lincrusta Walton." GLASGOW, 1883.
Warner, J., & Sons, *London*, for Lever Nut for Boiler Cock. LEICESTER, 1885.
Watson, Henry & Son, *Newcastle-upon-Tyne*, for "National" Water-closet. NEWCASTLE, 1882.
" " for Waste-preventing Flushing Syphon. NEWCASTLE, 1882.
" " for "Crown" Cottage Water-closet. NEWCASTLE, 1882.
Webb, A., *Dublin*, for the "Natural" Boot for Ladies. DUBLIN, 1884.
Webster & Co., *Nottingham*, for Webster's Photometer. CROYDON, 1879.
Wenham & Co., *Church Street*, *Croydon*, for Boyle's Mica-Valved Outlet Ventilator. CROYDON, 1879.
Wheeler, J., *Ilfracombe*, for "Pixene." GLASGOW, 1883. DUBLIN, 1884.
White, William, *Abergavenny*, for Hygeian Rock Building Composition. NEWCASTLE, 1882.
Whitwick Colliery Co., *Coalville*, *Leicester*, for their Exhibit of Terra Cotta. LEICESTER, 1885.
" " for Red Building Bricks. LEICESTER, 1885.
Wilby, W., *Dublin*, for Chain Belting for Machinery. DUBLIN, 1884.
Willcock & Co., *Burmantofts*, *Leeds*, for Fire-Clay Sanitary Sinks and Water Troughs. CROYDON, 1879.
Willey & Co., *Exeter*, for Gaseliers and Gas Brackets. EXETER, 1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Ransome's Artificial Stone Air Brick. EXETER, 1880.
" " for Conservatory Boiler, with Hot-Water Pipe. EXETER, 1880.

Wippell Bros. & Row, for Cottage Range. EXETER, 1880.
" " for Chappuis' Daylight Reflector. EXETER, 1880.
" " for Fernby's "Paragon" Camp Furniture. EXETER, 1880.
" " for Improved Housemaid's Box with Sifter. EXETER, 1880.
Woodhouse & Rawson, *London*, for their Magnetic Cut Out for Electric Lighting. LEICESTER, 1885.
Wortley Fire Clay Co., *Leeds*, for White Enamelled Straight and Curved Channels, and Channel Junctions for Inspection Chambers to Drains. LEICESTER, 1885.
Wragg, T., & Sons, *Burton-on-Trent*, for Gordon's Junction Blocks, for Lamp-holes and Inlets to Sewers. LEICESTER, 1885.
" " for Gordon's Disconnecting Trap. LEICESTER, 1885.
" " for Mawbey's Joint for Stoneware Pipes. LEICESTER, 1885.
Wright, A., *London*, for Sanitary Night Lights. LEICESTER, 1885.
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LIST OF FELLOWS, MEMBERS, ASSOCIATES, AND SUBSCRIBERS ELECTED DURING THE YEAR 1885.

FELLOWS.

1885. Feb. STRONG, Henry John, M.D., *Whitgift House, George Street, Croydon.*

MEMBERS.

* Life Members. † Passed Examination for Local Surveyors.

1885. Sep. *†ANGELL, John A., A.M.INST.C.E., 50, *Leyspring Road, Leytonstone, Essex.*

1885. Jul. BRACKETT, William, F.S.A., 42, *London Road, and 27, High Street, Tunbridge Wells.*

1885. Dec. BROWN, W. Ibbs, *St. Michael's Avenue, and Guildhall, Northampton.*

1885. Oct. CAMERON, SIR Charles A., F.R.C.S.I., C.S.S., 15, *Pembroke Road, Dublin.*

1885. Jul. *CASSAL, C. E., F.I.C., (EXAM.) F.C.S., 34, *Castlebar Road, Ealing.*

1885. Jan. *COOPER, John, Jun., *Croydon.*

1885. Feb. JERRAM, George B., A.M.INST.C.E., *Town Hall, Walthamstow.*

1885. Apr. *LE ROSSIGNOL, F., 1, *Gresham Buildings, Basinghall Street, E.C.*

1885. Jan. LONDON, Thomas, *Beeston Hill, Leeds.*

1885. Oct. MARCET, William, M.D., F.R.S., 39, *Grosvenor Street, W.*

1885. Sep. MILL, William, M.R.C.S., L.R.C.P., *Newbold, Shipston-on-Stour.*

1885. May. PERRY, William, *Hanbury Villa, Stourbridge.*

1885. May. TARBOTTON, M. Ogle, M.INST.C.E., *The Park, Nottingham.*

1885. Feb. *†TATTERSALL, W., 204, *Swan Arcade, Bradford.*

1885. May. TAYLOR, William F., M.D., M.R.C.S., L.S.A., *Brisbane, Queensland.*

1885. Apr. THOMAS, Walter, A.M.INST.C.E., *Fern Bank, and Town Hall, Dorchester.*

1885. Jan. TWELVETREES, W. Noble, 8, *City Road, E.C., and Hargrave House, Enfield.*

ASSOCIATES.

* Life Associates. ‡ Passed Examination for Inspectors of Nuisances.

1885. Sep. BROAD, Clement B., 4, *Rylett Road, Shepherd's Bush.*

1885. Nov. *‡BUGLER, W. J., *Alpha House, Putney.*

1885. Jan. BURROUGHS, S. M., *Snow Hill, E.C.*

1885. Dec. COBHAM, G. R., 3, *Edwin Street, Gravesend.*

1885. Dec. *‡EMPTAGE, D., *Dane Hill, Margate.*

1885. Jul. *‡HART, W. S., 29, *Coley Hill, Reading.*

1885. Apr. HOWE, George, 41, *Wigmore Street, W.*

1885. Jul. PEARCE, George Edward, *Dartford, Kent.*

1885. Jan. *‡POTTER, Ben, *Heathfield House, Broadway, Ealing.*

1885. Apr. SEDGWICK, Sydney, 10, *Mortimer Street, Cavendish Square, W.*

1885. Nov. *‡SIMMONS, Nimrod, 8, *Princes Place, Victoria Street, Clifton, Bristol.*

1885. Nov. *‡STANLEY, A. W., 12, *Midland Street, Hull.*

1885. Jul. *‡TAIT, James, 18, *Sandholes, Paisley.*

1885. Jun. *‡WILSON, George, 5, *Whitfield Street, Newark.*

INDEX OF PLATES.

PAGE

VIEWS AND SECTIONS SHOWING CONSTRUCTION OF ROMAN RESERVOIRS AND CONDUITS 36

DIAGRAM OF AQUEDUCT BRIDGE, RESERVOIRS, AND SIPHONS, FOR CROSSING THE VALLEY OF THE GARON 37

SKETCH OF REMAINS OF INTAKE RESERVOIR AT SOUCIEU 37

SKETCH OF AQUEDUCT BRIDGE OVER THE GARON 37

SKETCH OF REMAINS OF AQUEDUCT BRIDGE ACROSS THE VALLEY OF BONNAN 38

SKETCH OF ARCH OF AQUEDUCT BRIDGE AT BONNAN ... 38

DIAGRAM OF DIARRHŒAL RATE AND TEMPERATURE ... 88

MORTALITY CHART, LEICESTER COMPARED WITH OTHER TOWNS 88

PLAN SHOWING BED-SPACE IN CIRCULAR HOSPITAL WARD 216

PLAN SHOWING BED-SPACE IN PARALLELOGRAM-SHAPED WARD 217

SKETCH-MAP OF THE VALLEY OF THE SOAR 263

GENERAL INDEX.

PAGE

ACTS of Parliament, public and private, number of, table 318
Address, Anniversary 31
„ Annual 23
„ Inaugural, to Leicester Congress 49
„ to Section I. 73
„ to Section II. 146
„ to Section III. 246
„ to Working Classes, by Capt. Douglas Galton on "Prevention is better than Cure" ... 347
Adulteration and analysis of food 274, 278, 279
„ of milk, evils of 275
Aeration of water supply, Rome. 33
Air, amount of carbonic acid in... 251
„ on mountains, effects of 254, 261
„ analysis 275
„ at great altitudes..... 250
„ space in board schools..... 30
„ „ required in hospitals .. 208
„ „ in hospital wards 209
Alnwick, diarrhœal rate and subsoil water 92
Altitude, influence of, on respiration 254
Ambulance conveyance.....142, 145
„ teachings, objections 144
„ work, by J. H. Buckley..... 140
„ work in Leicester ... 141
Analysis of air 275
„ of food.....274, 278
„ Hygienic, by C. E. Cassal 272
„ public health 277
„ of water..... 275
Anemometers, errors in 238, 239
Angell, Lewis, on Impediments to sanitary progress..... 117
Anio novus, the 33
„ vetus, the..... 32
Anniversary Address, by Prof. W. H. Corfield 31
Annual Address, by Dr. A. Carpenter 23
„ report, Sanitary Institute 22
Antwerp hospital..... 214
Appian aqueduct 31

PAGE

Aqueduct Bridge, Bonnan..... 38
Aqueducts in Rome.....31, 32, 33
Aqueduct bridge, reservoirs and siphons for crossing the valley of the Garon, *diagram* 37
Aqueduct bridge, arch of, at Bonnan, *sketch*..... 38
Aqueduct bridge, remains of in the valley of Bonnan, *sketch*. 38
„ „ over the Garon, *sketch* 37
Areas of local government, complication of 293
Army, consumption in 65
„ and civilian death-rate compared..... 77
„ death-rate 52, 53, 55, 56, 65, 70
„ „ from fever ... 68
„ „ from consumption 65
„ hygiene 52, 53, 55, 56
„ sickness in 78
Arsenic, testing wall paper for... 273
Artisans' dwellings, death-rate in 359
Associates, &c., Sanitary Institute, elected during 1885, list of ... 444
Athletics in schools, advantage of 28
Atmospheric pressure and life ... 256
Augustan aqueduct..... 33
Awards of the Judges at Leicester Exhibition 371, 379

BACILLI of cholera 71, 348
Banbury, diarrhœal rate and subsoil water at 92
Barber, Mr., on the Countess de Viesca's paper 138
Basle, length and cost of sewers at 196
Balloon ascents, effect of, on breathing ... 255
„ ascent of Tissandier, Sivel, and Croce Spinelli 255
Barfoot, Mr. Alderman, on Dr. Buck's paper..... 95
Berlin, diarrhœa and subsoil water at 92
„ double system of sewers in 188
„ length and cost of sewers at 196

PAGE.
Birch, Peregrine, on Messrs. Underwood's and Gordon's papers..... 200
Birkenhead, diarrhœal death-rate 87
Birmingham, diarrhœal death-rate 87
Black Assizes, Oxford..... 79
Blackburn, diarrhœal death-rate.. 87
Bochum, length and cost of sewers at 196
Bolton, diarrhœal death-rate at .. 87
Bonnan Aqueduct Bridge 38
Bonnan, arch of aqueduct bridge at, *sketch* 38
" remains of aqueduct bridge across the stream in the valley of, *sketch* 38
Boulnois, H. P., on Rev. F. Lawrence's paper..... 284
Boundary Commissions 300
Bowdon, physical conditions of 85
" phthisis at 85
Bradford, density of population and duration of life at... 62
" diarrhœal death-rate at. 87
Brazil, small-pox in..... 81
Breathing, balloon ascents, effect of on 255
" carbonic acid, effect of at high altitudes..... 253, 254, 256
Breslau, length and cost of sewers 196
Bridge and Ferry Trustees, number of in England and Wales... 301
Brighton, diarrhœal death-rate at..... 87
Bristol, density of population and duration of life at..... 62
" diarrhœal death-rate chart and table 87, 88
" diarrhœal rate and subsoil water at 92
" Merchant Venturers' School warming, ventilation, and arrangement of..... 233
" subsoil 91, 95
Brussels, length and cost of sewers at 196
Brynmaur, diarrhœal rate and subsoil water at 92
Buchanan, Dr., on diarrhœal rate and subsoil water..... 92
Buck, Dr., on Mr. Buckley's paper 144
" on infantile diarrhœa 86
Buckley, J. H., on Ambulance work 140
Burial Boards, number of, in England and Wales 301
Burial in chalk, effect of 285
" in the ground, objections to 284
" in imperishable coffins 282

PAGE
Bye-laws for sanitary purposes... 120, 150

CAMERON, Sir Charles, on Dr. Buck's paper..... 95
" on J. H. Buckley's paper 145
" on the Countess de Viesca's paper ... 139
" on Lewis Angell's paper 122
" on Dr. Pringle's paper 114
Carbonic acid, absorption of, by vegetables 247
" amount of, in air... 251
" distribution of ... 249
" effect of inhaling.. 253
" estimated by smell 253
" expiration of, at great altitudes... 260
" given off by vegetables 248
" in nature, distribution of 246
" possibility of accustoming oneself to 253
" and pulmonary diseases 250
" sanitary relations.. 251
" in sea air 251
" amount given out by man and animals 246
" penetration of..... 247
Cardiff, diarrhœal death-rate ... 87
" " rate and subsoil water at..... 92
Carlisle, diarrhœal rate and subsoil water 92
Carlsruhe, length and cost of sewers..... 196
Carpenter, Dr. Alfred, Address at annual meeting..... 23
" on Dr. Buck's paper... 96
" on Dr. Pringle's paper 114
Cash account, Sanitary Institute. 22
Cassal, C. E., on Hygienic analysis 272
Certificates awarded at Exhibitions of the Sanitary Institute, alphabetical list of 424
Certificates awarded at Exhibitions of the Sanitary Institute, classified list of..... 401
Certificates awarded at Leicester Exhibition 373, 380
" for plumbers 243
Cesspools, emptying of, on the Continent 193
" objections to..... 157

PAGE
Cesspools, question as to right of pollution by 272
Chalk, effect of burial in 285
Chart of diarrhœal death-rate, Leicester, Liverpool, London, and Bristol 88
Chelmsford, diarrhœal rate and subsoil water 92
Cheltenham, diarrhœal rate and subsoil water 92
Chemical phenomena of respiration, influence of altitude on... 254
Chemnitz, length and cost of sewers at 196
Chemistry, meteorology, and geology, Address by Dr. Marcet.. 246
Children, death-rate of 63
Chimneys, size of 223, 226
Chlorate of potash in place of oxygen 256
Cholera bacillus 71, 348
" cause of 348
" death-rate from 69
" death-rate in England... 76
" epidemics in England... 70
" " in Europe ... 69
" in India 352
" in India, deaths from ... 353
" infectiousness of 355
" inoculation for 71
" mortality from..... 69
" preventive measures...70, 71
Churchwardens, number of, in England and Wales..... 301
Circular Hospital wards, by H. Saxon Snell 205
Circular wards, objection to 213
Circular hospital ward, *plan* 216
Claudian aqueduct 33
Cleanliness in cooking 132
Climate and death-rate in India. 54, 55
" " West India 55
Coffins, danger from use of imperishable 282
Coles, Mr., on E. C. Robins' paper 238
" on Smoke abatement...218, 369
" on F. Scott's paper 244
College of health 23
Collingridge, Dr., on J. H. Buckley's paper..... 144
Collins, H. H., on Lewis Angell's paper 122
" on H. Saxon Snell's paper 214
Cologne, length and cost of sewers 196
Commissioners of baths and washhouses, number of, in England and Wales 301
Commissioners of sewers (extra Metropolitan) number of 301
Compulsory vaccination in Germany 113

PAGE
Conference at Health Exhibition 20
Congresses held by the Institute 40
Congress at Leicester 43
" closing meeting... 367
" Inaugural Address 49
Conservancy boards, number of, in England and Wales..... 301
Construction and materials of Continental sewers 187
Consumption in the army 65
" and butter 65
" and climate 85
" death-rate from ... 64
" and impure air ... 65
" origin of 64
Continent, precipitation and sewage irrigation on the 194
Continental house drainage 191
" sewage disposal..... 193
" sewers, depth and mode of laying 186
" " flushing arrangements 186
" " materials and construction of 187
" " ventilation of ... 189
" towns, drainage of..... 181
Continental towns, table showing statistics relating to the drainage of..... 192
Conduits and reservoirs, Roman, sections showing construction of, *views*..... 36
Cooking, cleanliness in 132
Co-operation of Sanitary Societies 20, 23
Corfield, Prof. W. H., on Dr. Pringle's paper..... 113
" on Water supply of Ancient Roman Cities ... 31
Cottage-Home principle for schools 163
County Authorities, number of, in England and Wales 301
" " for Local Government ... 310
County Boards for Sanitary purposes 119
Cowl Committee, Sanitary Institute 238, 239
" Experiments 19
Crefeld, length and cost of sewers 196
Cremation and poisoning ... 283, 285
" reasons against 283
" and small-pox hospitals 285
Crimea, the, and Hygiene 51
Croce Spinelli, Sivel, and Tissandier, balloon ascent of..... 255
Croydon, Exhibition held at 391

PAGE

DANGER to health arising from burial in imperishable coffins, by Rev. F. Lawrence 282
Dantzic, table of death-rate at ... 197
" length and cost of sewers 196
" sewerage works 182, 185, 187, 189, 193, 196
Day, Ernest, on Mr. Robins' paper 238
Death-rate and climate in India 54, 55
" in the army 52, 55, 56, 65, 77, 78
" of children 63
" from cholera..... 69
" from cholera in India 353
" from consumption ... 64
" from diarrhœa in large towns 87
" in England 61
" in England and Wales for 25 years, table. 125
" in England, table of... 76
" from fever in the army 68
" " in England 67, 70, 76
" in the Indian Army... 53, 55
" of London in the crowded parts..... 159
" in prisons 79
" reduction of, after sewage works, in Continental towns. 205
" from small-pox in India 104
" from small-pox, Leicester 112
" in West Indian Army. 56
De Chaumont, Prof. F., Address to Congress..... 49
" on Mr. Coles' paper 225, 226
" estimate of air space for hospital wards..... 208
" on height of hospital wards..... 210
" on Dr. Pringle's paper 115
" on Mr. Robins' paper 239
" on H. Saxon Snell's paper 214
" on Mr. Scott's paper 245
" on Messrs. Underwood and Gordon's papers ... 201
" on ventilation..... 240
" on W. Whitaker's paper 272
Deodorising and precipitating sewage, and purifying and softening water by sodium aluminate 280

PAGE

Derby, diarrhœa death-rate at..... 87
Destructors for sewage and refuse..... 156
Diarrhœa, causes of..... 96
" character of 87
" bacilli 93, 97
" death-rate in Leicester, Liverpool, London, and Bristol, chart of 88
" &c., death-rate from, in England..... 76
" death-rate from, in large towns, table .. 87
" death-rate and temperature..... 88
" Infantile, by Dr. W. E. Buck 86
" Infantile, causes of ... 89, 90, 94, 96, 98
" and maternal neglect.. 89
" origin of..... 88
" pathology of 93
" relation to subsoil water...91, 92, 93, 95, 98
" and subsoil water at Berlin..... 92
Diphtheria, death-rate from, in England 76
Disposal of sewage in continental towns 193
Districts under one authority ... 289
Division of England by river basins 268
Dock, Harbour, and Pier Authorities, number of, in England and Wales 301
Dolan, Dr., on Countess de Viesca's paper 139
Domestic sanitary management... 128
Dortmund, length and cost of sewers at 196
Dover, diarrhœal rate and subsoil water at..... 92
Drainage of continental towns, by J. Gordon..... 181
" Embankment, and Conservancy Boards, number of, in England and Wales 301
" of houses in continental towns 191
" of Continental towns, table showing statistics relating to the 192
Dublin subsoil 95
Düsseldorf, length and cost of sewers at 196
Dust, floors impervious to ... 131, 135, 138

PAGE

Dwellings of the Poor, Royal Commission on.....25, 158

ECONOMIC aspect of the smoke question 220
Editing committee 6
Effluent water, sewage works, Leicester 174
Eisenach, length and cost of sewers at 196
Ellice-Clark, J., on Countess de Viesca's paper..... 137
" on J. Underwood and J. Gordon's papers... 202
Ely, diarrhœal rate and subsoil water at..... 92
Emptage, D., on E. C. Robins' paper 239
" on F. Scott's paper ... 244
Engineering and architecture, Address by Percival Gordon Smith..... 146
England, cholera epidemics in ... 70
" death-rate in 61, 76
" & Wales, number of houses in 360
" " number of local authorities in ... 301
" " table of death-rate for 25 years 125
" " table of rivers and watershed areas .. 335
Erfurt, length and cost of sewers 196
Essentials of local government reform, by Ernest Hart 287
Everard, J. B., on Rev. F. Lawrence's paper..... 284
Examinations of the Institute 19, 59, 385
Examination of plumbers 243
" for local surveyors and inspectors of nuisances 385
" syllabus of subjects for.....386, 387
Examiners, Sanitary Institute, board of..... 385
Exeter, Exhibition held at..... 391
Exhibitions held by the Sanitary Institute 391
" of sanitary apparatus and appliances 390
Exhibits selected for further practical trial at Leicester Exhibition 375
Expenditure and receipts of local authorities since 1868. Table.. 345
Expenses of local government, growth of 327

FARR, Dr., publication of works of..... 20

PAGE

Fellows &c., elected during 1885, list of 443
Fevers, death-rate from, in England 76
" " in England..... 67
" " in the army ... 68
Field, Rogers, on E. C. Robins' paper 238
" on J. Underwood and J. Gordon's papers 201
Floors and floor coverings..... 131, 135, 138
" impervious to dust..... 131, 135, 138
Flushing arrangements of Continental sewers..... 186
Flushing of sewers at Hove..... 203
Food analysis and adulteration... 274, 278, 279
Fowler, A. M., on J. Underwood and J. Gordon's papers 203
" on Countess de Viesca's paper 135
Frankfort-on-the-Main, length and cost of sewers... 196
" sewerage 182–196

GALTON, Capt. Douglas, Address to the working classes on "Prevention is Better than Cure" ... 347
" on C. E. Cassal's paper. 278
" estimate of air space for hospital wards ... 208
" on Rev. F. Lawrence's paper..... 285
" on Lewis Angell's paper 122
" on size of hospitals ... 209
" on H. Saxon Snell's paper..... 214
" on Messrs. Underwood and Gordon's papers. 200
" on W. Whitaker's paper 272
Garon, aqueduct bridge over the. 37
" aqueduct bridge, reservoirs and siphons for crossing the valley of the, *diagram*..... 37
Gas apparatus for heating and cooking..... 221
" reduction of price 225
" stoves in Leicester Exhibition 379
" " smell from..... 227
Geological formation of Leicester 262
Geology, meteorology, and chemistry, Address by Dr. Marcet... 246
Germany, plans of house drainage in 102
" sanitary movement in. 181
" compulsory vaccination in 113

PAGE
Germs and disease 348
Glasgow, Exhibition held at 391
Gordon, J., on W. R. E. Coles' paper..... 227, 369
" on the drainage of continental towns..... 181
Government grants, amount of... 327
" Local. *(See Local government)*.....
Grimson, Dr., on Dr. Buck's paper 96
Ground space, overcrowding in... 161
Gymnastics in schools, advantage of 29

HALIFAX, diarrhœa death-rate.. 87
Halle, length and cost of sewers 196
Hamburg, length and cost of sewers 196
Hancock, Mr., on Dr. Buck's paper 95
Hanover, length and cost of sewers..... 196
Harbour, Pier, and Dock authorities, number of, in England and Wales 301
Hart, Ernest, on W. R. E. Coles' paper 223, 369
" Lecture to the Congress, by, on "The Essentials of Local Government Reform" 287
Health aspect of smoke abatement 218
" Exhibition, conference at 20
" " surplus funds 24
Healthy houses..... 359
Heating methods, improvements in 220
Heidelberg, length and cost of sewers..... 196
High-pressure hot-water heating 232, 235
Highway authorities, number of, in England and Wales..... 301
History of sewage and sewage treatment at Leicester, by John Underwood 164
Hollingworth, Dr., on Dr. Buck's paper 96
Homberg, length and cost of sewers..... 196
Horrocks, Mr., on Countess de Viesca's paper 138
Hospitals, air space required in... 208
Hospital wards, air space in 209
" " arrangement and cost of..... 212
" " cost of 208
" " floor space in ... 209
" " height of 210

PAGE
Hospital wards, objection to small size 207
" " by Saxon Snell... 205
" " circular shaped, *plan* 216
" " parallelogram shaped, *plan* ... 217
Hot water heating, high pressure 232, 235
House drainage in Continental towns 191
" " plans of, on the Continent 192
Houses, healthy condition of ... 359
House management, by Countess de Viesca 128
Housing of the poor 25
Houses, number of, in England and Wales 360
Hove, flushing of sewers at 203
Huddersfield, diarrhœa death-rate 87
Hull, diarrhœa death-rate 87
Hygiene in the Army ...52, 53, 55, 56
" and the Crimea 51
Hygienic analysis, by C. E. Cassal 272

IMPEDIMENTS to Sanitary Progress, by Lewis Angell 117
Infant mortality in Leicester..... 73
Infantile diarrhœa, by Dr. W. E. Buck 86
" " causes of...89, 90, 94
India, cholera in 35
" climate and death-rate in 54, 55
" death-rate from small-pox in..... 104
" small-pox in 99, 103
" army, death-rate in 53, 55
Infectiousness of cholera 355
Inoculation for cholera 71
" Pasteur's experiments on 72
" of small-pox 114, 116
Inspectors of nuisances, examinations for 19, 59, 385
" who have passed the examination of the Sanitary Institute during 1885 388
Inspection of plumbers' work ... 244
Irrigation and precipitation of sewage on the Continent 194
" scheme for sewage of Leicester..... 180
Isolation measures for small-pox, Leicester.. 107

JERRAM, G. B., on Countess de Viesca's paper..... 136

PAGE
Jerram, G. B., on Lewis Angell's paper..... 122
Joint Boards, number of, in England and Wales 301
Jones, Lieut.-Col., on J. Underwood and J. Gordon's papers .. 199
Judges, report and the awards of the, at Leicester Exhibition... 371, 379
Judges, List of 48
Julian aqueduct 33

KEMPSON, Alderman, on Rev. F. Lawrence's paper ... 285
" on Messrs. Underwood and Gordon's papers 199
Kitchen, sanitary management of 132, 133
Koch, Dr., on the cause of cholera 348
Königsberg, length and cost of sewers 196

LACTOMETER and milk-testing 273, 277
Ladies' province in sanitation, 129, 139
Lawrence, Rev. F., on the danger to health arising from burial in imperishable coffins..... 282
Laws, Mr., on J. Underwood's and J. Gordon's papers 200
Leamington, Exhibition held at.. 391
Lecture to the Congress on "Essentials of Local Government Reform," by Ernest Hart 287
Legal decision in connection with water supply from wells, by W. Whitaker 268
" decision as to pollution of well and underground water 269
Legislation as to overcrowding... 160
Leeds, diarrhœal death-rate at ... 87
Leicester, Ambulance work in ... 141
" " number of certificates given 143
" amount of sewage and rainfall at 204
" chart of diarrhœal death-rate at..... 88
" diarrhœal death rate at.. 87
" death-rate from small-pox at..... 112
" diarrhœal rate and subsoil water at..... 92
" density of population and duration of life at..... 62
" Exhibition held at 391
" " exhibits selected for further practical trial at..... 375

PAGE
Leicester Exhibition, gas stoves in 379
" geological formation of. 262
" isolation measures for small-pox at 107, 112
" immunity from small-pox at..... 106
" Mr. Lee's report on sanitary condition of 168
" Exhibition, report and awards of the Judges at 371, 379
" river water, analysis of.. 267
" sanitary condition of, Mr. Wickstead's report on 167
" sewage, irrigation scheme for..... 180
" sewage precipitation works 173
" sewerage and sewage treatment, John Underwood on 164
" sewage scheme 199, 204
" sewage works, effluent water 174
" sewers, dimensions of... 171
" smoke abatement in ... 227
" Exhibition, supplementary report of the Judges at 379
" underground water, analysis of 266
" water-bearing strata of.. 266
" water-supply of 266
" compared with other towns, *mortality chart* 88
" Congress at 43
Leipzig, length and cost of sewers at 196
Lemon, J., on Countess de Viesca's paper 139
" on J. Underwood's and J. Gordon's papers ... 198
Lee's, Mr., report on sanitary condition of Leicester 168
Library, donations to during 1885 439
Life at great altitudes..... 259
" under low atmospheric pressure 256
Lighting and watching inspectors, number of, in England and Wales 301
Linz, length and cost of sewers... 196
Living rooms, carbonic acid in ... 252
Liverpool, chart of diarrhœal death-rate 88
" density of population and duration of life 62
" diarrhœal death-rate 87
Loans for sanitary purposes 147
Local Acts, objections to 150

PAGE
Local administration 290, 291
„ authority, constitution of.. 291
„ authorities, expenditure and receipts since 1868, table... 345
„ „ number of, in England and Wales, table... 301
„ „ treasury subventions to, table of 331
„ „ unification of.... 302
„ government, army of present officials... 309
„ „ board Acts 147
„ „ board, loans for sanitary purposes 147
„ „ board, model bye-laws ... 120, 151, 164
„ „ central authority 324
„ „ composition of. 334
„ „ constitution of primary authority 307
„ „ County authorities for 310
„ „ County authorities and private bills..... 318
„ „ duties of County authorities ... 314
„ „ duties of primary authority 308
„ „ finance 325
„ „ growth of expenditure ... 326
„ „ intermediate authority 313
„ „ position of large boroughs..... 305
„ „ primary authorities 301
„ „ reform, need of 287
„ „ staff of primary authorities ... 309
„ „ unit of..... 295
„ indebtedness, growth of ... 327
„ „ each seven years, ending 1883, table 346
„ loans, amount of 327
„ table 328
„ sanitary authorities, contribution of 152
„ self-government. importance of 288
„ surveyors, examinations for 19, 59, 385

PAGE
Local taxation 329
London, chart of diarrhœal death-rate in..... 88
„ death-rate in crowded parts of 159
„ density of population in 61, 62
„ diarrhœal death-rate in 87
Ludwigsburg, length and cost of sewers at 196
Ludwigshafen, length and cost of sewers at 196
Lugdunum, the water-supply of.. 35
Lyons, water-supply of 35
Lyte, F. Maxwell, on the use of sodium aluminate for softening and purifying hard and impure water, deodorising and precipitating sewage, waste water from factories, &c. 280

MACCLESFIELD, diarrhœal rate and subsoil water..... 92
Maguire, W., on the Countess de Viesca's paper 139
Manchester, density of population and duration of life 62
„ diarrhœal death-rate in 87
„ prevention of smoke in 225
Marcet, Dr. W., Address on chemistry, geology, and meteorology 246
„ on Dr. Buck's paper 94
„ on C. E. Cassal's paper ... 278
„ on Rev. F. Lawrence's paper 284, 286
„ on J. D. Paul's paper 267
„ on W. Whitaker's paper. 272
Marcian aqueduct 33
Markets and fairs commissioners, number of, in England and Wales 301
Mayence, length and cost of sewers 196
Measles, death-rate from, in England..... 76
Medals awarded at the Exhibitions of the Sanitary Institute, alphabetical list of 417
Medals awarded at the Exhibitions of the Sanitary Institute, classified list of..... 392
„ and starred certificates awarded at Leicester Exhibition 372, 379
Medical officers of health difficulties of position 121
„ „ for local government 310

PAGE
Medical officers of health, table of districts 321
„ supervision of elementary schools 29
Members, &c., elected during 1885, list of 443
Merchant Venturers' school, Bristol, warming, ventilation, and arrangement of..... 233
Merthyr, diarrhœal rate and subsoil water 92
Meteorology, geology, and chemistry, Address by Dr. W. Marcet 246
Metropolitan sanitary authorities, number of 301
Mexico, small-pox in 81
Milk adulteration, evils of 275
„ testing and lactometers 273, 277
Mill, J. S., on the unification of Local Government 304
Moabite hospital, air space and floor space in..... 209
Model bye-laws, Local Government Board 151, 164
Money value of sanitation.....60, 365
Moore, Dr., on J. H. Buckley's paper 145
Moral aspect of the smoke question 219
Morality and sanitation 357
Morpeth, diarrhœal rate and subsoil water at 92
Mortality in the army, table of... 77
„ from cholera 69
„ of Leicester, compared with other towns, *chart* 88
„ and sewerage of Continental towns, table showing statistics ... 192
Moses and sanitation 352
Mott, F. T., on C. E. Cassal's paper 278
„ on Rev. F. Lawrence's paper 284
„ on J. D. Paul's paper . 267
„ on Dr. Pringle's paper 114
Mountain air, the effects of 254, 257, 261
Munich, length and cost of sewers 196
Municipal corporations, number of, in England and Wales 301

NEWCASTLE-ON-TYNE, diarrhœal death-rate at 87
„ Exhibition held at. 391
Newport, diarrhœal rate and subsoil water at 92
Nightingale, Miss, on the size of hospital wards 208, 209

PAGE
Norwich diarrhœal death-rate ... 87
Nottingham diarrhœal death-rate 87
Nuremburg, length and cost of sewers at 196

OLDHAM, diarrhœal death-rate.. 87
Overcrowding on ground space... 161
„ legislation as to... 160
„ in schools 163
Over-pressure in elementary schools 27
Overseers of Poor Law Parishes, number of, in England and Wales 301
Oxford Black Assizes 79
Oxygen, deficiency of, at great altitudes..... 256

PAGET, Alderman, on C. E. Cassal's paper 279
Papers read before the Institute during 1885 438
Parallelogram hospital ward, *plan* 217
Paris, length and cost of sewers 196
„ sewage disposal at 200
Parish division for Local Government 297
Pasteur's inoculation experiments 72
Paulson, Dr., on J. Underwood's and J. Gordon's papers 203
Penrith, diarrhœal rates and subsoil waters at 92
Penzance, diarrhœal rate and subsoil water at 92
Phthisis in crowded schools 30
„ death-rate from, in England..... 76
„ at Bowdon..... 85
Physical exercise in schools 28
Plans of house drainage on the Continent 192
Plumbing and plumbers' work, by F. Scott 241
Plumbers, certificates for 243
„ examination of 243
„ Guild of London, action taken by..... 243
„ registration of 242
„ teaching for 243
„ work, inspection of ... 244
Plymouth, diarrhœal death-rate in 87
Pneumatic emptying of cesspools 193
Pollution of well and underground water, decision as to 269
Poisoning and cremation ... 283, 285
Poor, dwellings of the 25, 158
Poor-law boards of guardians, number of, in England and Wales 301
„ rating, unfairness of present system 315

PAGE
Population, density of, and duration of life, table.. 62
„ of large towns, density of..... 62
„ of large towns in England, table 305
Port sanitary authorities, number of, in England and Wales 301
Portsmouth, diarrhœal death-rate at..... 87
Precipitating and deodorizing sewage, and purifying and softening water by sodium aluminate 280
Precipitation and sewage irrigation on the Continent..... 194
„ of sewage at Leicester 172
„ of sewage, various schemes tried at Leicester 179
Presidents of Congresses held by the Institute 40
Preston diarrhœal death-rate at 87
„ subsoil and ground water 91
Preventible diseases 63
Prevention is better than cure, address to the working classes by Capt. Douglas Galton 347
Pringle, Surg.-Major, on Dr. Buck's paper 95
„ on Countess De Viesca's paper 134
„ vaccination *versus* isolation 99
Prisons, death-rate in 79
Producer gas for steam boilers... 228
Public analyst, duties of..... 274
„ health and analysis..... 277
„ „ Act, defects in 120
Pulmonary diseases and carbonic acid 250

QUARANTINE, uselessness of ... 70

RAINFALL, quantity reaching sewers 185, 205
„ in sewers on the Continent, provision for 184
„ as a source of water supply 156
Ransome, Dr. A., Address on sanitary science and preventive medicine 73
„ on Dr. Buck's paper ... 94
„ on Dr. Pringle's paper. 113
Rateable value, growth of..... 327
Rates, receipts from 327

PAGE
Rating, poor-law, unfairness of present system..... 315
Receipts and expenditure of local authorities since 1868. Table.. 345
Refuse and sewage, destructors for 156
Registration of plumbers.....242, 244
Report of the Council, Sanitary Institute..... 17
„ of the Judges at Leicester Exhibition 371, 379
Reservoirs and conduits, Roman, sections showing construction of, *views*..... 36
Reservoir, intake, at Soucieu, *sketch* 37
Reservoirs, siphons and aqueduct bridge, for crossing the valley of the Garon, *diagram* 37
Respiration at great altitudes ... 256
„ influence of altitude on 254
Rivers of England and Wales, catchment basins and watershed areas. Table..... 335
Rivers and sewage flow, proportion between..... 195
River water, Leicester, analysis of 267
Robins, E. C., on F. Scott's paper 244
„ on H. Saxon Snell's paper 215
„ on ventilation and warming chemical laboratories and applied science schools generally...228, 369
Robinson, Prof. H., on J. Underwood and J. Gordon's papers... 199
Rome, account of water supply... 34
Roman aqueducts 31, 32, 33
„ cities, water supply of, by Prof. Corfield 31
„ reservoirs and conduits, sections showing construction of, *views* 36
„ settling reservoirs..... 33
„ water pipes, construction of 38
Royal commission on dwellings for the poor ... 158
„ on housing of the poor..... 25
„ on the Indian army 53
Rowley, Walter, on Countess de Viesca's paper 136
Rural sanitary authorities, number of, in England and Wales 301
„ districts, number of, in England and Wales 301

ST. BERNARD, respiration experiments at 258

PAGE
Salisbury, diarrhœal rate and subsoil water at 92
Salford, diarrhœal death-rate at.. 87
Sanitary Act of 1774 80
„ „ insufficiency of, 121, 122
„ condition of Leicester, Mr. Lee's report on ... 168
„ condition of Leicester, Mr. Wickstead's report on 167
„ house management, by Countess de Viesca ... 128
„ Institute annual address 23
„ „ „ report.. 17
„ „ cash account 22
„ „ commencement of 50
„ „ cowl committee.. 19, 238, 239
„ „ papers read before the during 1885 438
„ „ Presidents of congresses held by the 40
„ „ report of the Council 17
„ knowledge, diffusion of.. 125
„ League 125
„ management, domestic.. 128
„ management of kitchen 132, 133
„ movement in Germany and Switzerland 181
„ progress, impediments to, by Lewis Angell... 117
„ purposes, loans for 147
„ Reform Societies 127
„ Reform and Voluntary effort, by F. Scott ... 123
„ relations of carbonic acid 251
„ Science and Preventive Medicine, Address by Arthur Ransome, M.D. 73
„ Societies, co-operation of 19, 23
„ teaching 124
„ „ in schools...136, 138
„ „ of servants, 136, 137
„ works, public advantages 148
„ „ total outlay 148
Sanitation and morality..... 357
„ in the army.....52, 53, 55, 56
„ ladies province in..... 129
„ money value of..... 60
„ and Moses 352
„ progress of..... 49
Saxon Snell on hospital wards... 205
Scarlet fever, death-rate from, in England 76
School boards, number of, in England and Wales. 301
„ air space in 30

PAGE
Schools, cottage home principle for 163
„ grants, amounts of 332
„ medical supervision of elementary 29
„ overcrowding in 163
„ overpressure in elementary 27
„ phthisis in crowded..... 30
„ physical exercise in ...28, 29
„ sanitary teaching in... 136, 138
Science schools &c., E. C. Robins, on the ventilation of 228
Scott, Fred., on W. R. E. Coles' paper 225, 369
„ on plumbing and plumbers' work 241
„ on sanitary reform and voluntary effort 123
Scotton, Mr., on the Countess De Viesca's paper 137
Sea air, carbonic acid in..... 251
Servants, sanitary teaching of .. 136, 137
Sewage deodorised and precipitated by sodium aluminate..... 280
„ disposal in Continental towns 193
„ disposal at Paris 200
„ irrigation and precipitation on the Continent 194
„ irrigation scheme for Leicester 180
„ and rainfall, amount of, at Leicester 204
„ and refuse, destructors for 156
„ and riverflow, proportion between 195
„ scheme, Leicester..... 199
„ treatment by precipitation at Leicester 172
„ works, Leicester, effluent water 174
„ works, reduction of death-rate after, in Continental towns 205
„ works, table of death-rate in Dantzic before and after 197
Sewerage of Frankfort.....182, 196
„ and mortality of Continental towns, table showing statistics ... 192
„ and sewage treatment, John Underwood on. 164
„ works in Dantzic 182, 185, 187, 189, 193, 196
Sewers in Continental towns, table of length and cost of ... 196

PAGE
Sewers, depths and modes of flushing Continental ... 186
„ dimensions of Continental 186, 188, 189
„ double system of in Berlin 188
„ flushing arrangements of Continental 186
„ flushing of, at Hove..... 203
„ of Leicester, dimensions of 171
„ materials and construction of Continental 187
„ quantity of rainfall reaching 185, 205
„ rainfall in, provision for on the Continent 184
„ ventilation of Continental 189
„ „ by open gratings.. 202
„ „ by soil pipes...201, 202
Shaw, Dr., on Dr. Buck's paper... 94
Sheffield, diarrhœal death-rate in 87
Simpson, Dr. W. J., on Countess de Viesca's paper 135
Siphons, reservoirs and aqueduct bridge, for crossing the valley of the Garon, *diagram* 37
Sivel, Tissandier, and Croce Spinelli, balloon ascent of 255
Small-pox in Brazil..... 81
„ death-rate from, in 1871 80
„ „ in England..... 76
„ „ in India 104
„ in India..... 99, 103
„ inoculation for 114
„ isolation measures for, Leicester..... 107
„ Leicester death-rate from 112
„ „ immunity from 106
„ in Mexico 81
„ in the Prussian Army. 83, 84
„ ravages in the sixteenth, seventeenth, and eighteenth centuries ... 81, 113
„ and vaccination, Arthur Ransome on 80
„ vaccination *versus* isolation, by Dr. R. Pringle 99
Smith, Percival Gordon, address by, engineering and architecture 146
„ on W. R. E. Coles' paper 223
„ on H. Saxon Snell's paper 215
„ on J. Underwood and J. Gordon's papers ... 198
Smoke abatement, by W. R. E. Coles 218
Smoke Act, evasion of 224
„ as an antiseptic and deodoriser 219, 225
„ effects of, on vegetation 224
Snell, H. Saxon, on circular hospital wards 205

PAGE
Snell, H. Saxon, on E. C. Robins' paper 237
Soar river, derivation of name ... 262
„ valley of the, by J. D. Paul 261
„ „ „ *Map* 263
Sodium aluminate, for softening and purifying water and deodorising and precipitating sewage 280
Softening and purifying water, and deodorising and precipiting sewage by sodium aluminate..... 280
Soucieu, intake reservoir at, *sketch* 37
Sources of smoke 222
Spiers, Phéne on Mr. Coles' paper. 226
Stafford, Exhibition held at 391
Standard for water analysis 279
Starch formed by plants, account of 249
„ produced by assimilation of carbon 248
State medicine, committee on, 1866 .....323, 336, 341
„ „ extract from Dr. Rumsey's memorandum 336
„ „ Memorial of British Medical and Social Science Associations 341
Stephen, J. T., on Dr. Pringle's paper 115
Stratford, diarrhœal rate and subsoil water at 92
Stuttgart, length and cost of sewers 196
Subsoil, Bristol 91, 95
„ Dublin 95
„ and diarrhœa...91, 92, 93, 95, 96, 98
„ and diarrhœa, Berlin ... 92
„ water and diarrhœal rate, table of 92
Sunderland, diarrhœal death-rate 87
Surveyors and inspectors, examinations for ... 19, 59, 385
„ who have passed the examinations of the Sanitary Institute during 1885 388
Swete, Dr., on Dr. Buck's paper. 94
Switzerland, sanitary movement in 181
Symons, G. J. on C. E. Cassal's paper 279
„ on Dr. Buck's paper ... 95
„ on Rev. F. Lawrence's paper 285
Sykes, Dr., report to Section I. 368
„ on Countess de Viesca's paper 137

PAGE

TABLE of annual death-rate from diarrhœa in summer quarters of 10 years 1874-83 87
„ of death-rate in Dantzic before and after sewage works 197
„ of death-rates in England. 76
„ of death-rate in England and Wales for 25 years... 125
„ of diarrhœal rate and subsoil water 92
„ of local authorities in England and Wales 301
„ of local indebtedness each seven years ending 1883 346
„ of local loans..... 328
„ of medical officers of health districts 321
„ of money spent on new sewerage and sewage disposal works in 33 chief towns 196
„ of mortality in the army... 77
„ of number of public and private acts 318
„ of population of large towns in England..... 305
„ of receipts and expenditure of local authorities since 1868..... 345
„ of rivers of England and Wales, catchment basins, watershed areas 335
„ of sewerage works in continental towns 196
„ of Treasury subventions to local authorities 331
„ showing statistics relating to the Drainage of Continental towns 192
Tabular statement of the principal rivers of England and Wales, of which the catchment basins or watershed areas exceed in extent 250 square miles 335
Taxation, local 329
Tattersall, W., on Mr. Coles' paper 226
Teaching for plumbers 243
Temperature and diarrhœal death-rate 88
Tent hospitals 215
Tissandier, Sivel, and Croce Spinelli, balloon ascent of 255
Tepulan aqueduct 33
Tolls, dues, &c., amount of..... 327
Towns visited by the Institute... 40
Treasury subventions to local authorities 331

PAGE

Tuberculous diseases in general, death-rate from, in England... 76
Turnpike trustees, number of, in England and Wales..... 301
Typhoid fever, origin of..... 67
Typhus fever, origin of 67

UNDERGROUND water-pollution of, legal decision as to..269, 270
„ „ Leicester, analysis of 266
Underwood, John, on the History of sewage and sewage treatment at Leicester..... 164
Union divisions..... 297
Urban sanitary authorities, number of, in England and Wales.. 301
Use of sodium aluminate for softening and purifying hard and impure water, deodorising and precipitating sewage, waste water from factories, &c., by F. Maxwell Lyte 280

VACCINATION and medical treatment..... 111
„ benefits of 82
„ diseases conveyed by 111
„ Prof. de Chaumont on 72
„ in Germany..... 83
„ lymph, precautions as to..... 106, 109
„ objections to 109
„ *versus* isolation, by Dr. R. Pringle..... 99
Valley of the Soar, by John D. Paul 261
Vegetable physiology 248
Ventilation and warming of chemical laboratories and applied science schools generally, by Edward Cookworthy Robins..... 228
„ of continental sewers 189
„ of science schools, quantity required... 231, 232, 236, 238, 240
„ of sewers by open gratings..... 202, 205
„ of sewers by soil pipes 201, 202
„ openings, position of. 237, 238, 240
„ by window..... 137
Vienna, length and cost of sewers 196
Village water supply, contamination of 155, 157
Virgo aqueduct..... 33

PAGE
WALL papers, testing for arsenic 273
Warming of science school... 232, 235
Warwick, diarrhœal rate and subsoil water 92
Water analysis 275, 278
" " standard for..... 279
" bearing strata, Leicester... 266
" carbonic acid in 247
" pipes, Roman, construction of 38
" softened and purified by sodium aluminate and sewage deodorised and precipitated by it..... 280
Watershed areas and catchment basins of rivers of England. Table ... 335
" areas for local government, difficulties as to 313
" area, local government 312
" and water supplies... 317
Water supply of Ancient Roman Cities, by Prof. Corfield..... 31
" contamination by cesspools 157
" dangers arising from 154
" of Leicester 266
" of Rome, account of 34
" of villages, contamination of ...155, 157
Water supply from wells, legal decision as to, by W. Whitaker 269
Well water, pollution of, legal decision as to..... 269
" " supply from, legal decision in connection with 269
West India, army hygiene..... 55
Whitelegge, Dr., on C. E. Cassal's paper 279
" on Rev. F. Lawrence's paper..... 285
Whitaker, W., on legal decisions as to water supply from wells. 268
Wickstead's, Mr., report on sanitary condition of Leicester ... 167
Wiesbaden, length and cost of sewers..... 196
Windley, Ald., on Dr. Buck's paper 96
" on Dr. Pringle's paper... 112
Window ventilation..... 137
Wolverhampton, diarrhœal death-rate at..... 87
Workhouses, regulation of..... 315
Working classes, Address to, at Leicester 347
" " dwellings for the 25, 158
Worthing, diarrhœal rate and subsoil water at 92

ZURICH, length and cost of sewers at 196

For the awards given by the Institute see Appendix, page 418.

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For the awards given by the Institute see Appendix, page 422.

For the awards given by the Institute see Appendix, page 422.

Special Medal of Merit.

The only Medal given for Filters by the Institute,

AFTER COMPETITIVE TRIAL.

See Transactions, March, 1878.

OFFICIAL REPORTS
ON
WATER PURIFICATION.

From "The XIX. Army Medical Report" for 1877, *p.* 143.

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From "The XX. Army Medical Report" for 1878, *p.* 156.

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XIX. "Army Medical Report," pp. 170-171.

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VI. "Report on Rivers' Pollution,' p. 220.

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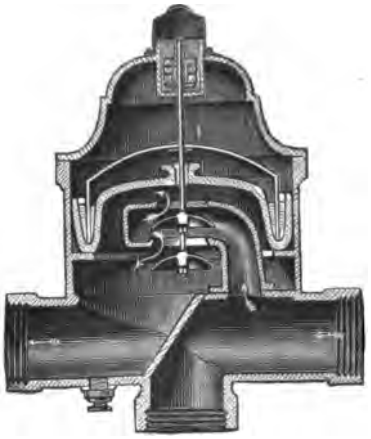

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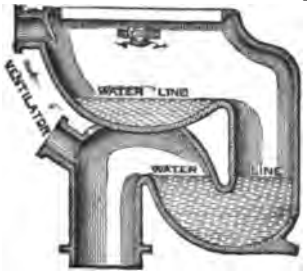
TWYFORD'S "NATIONAL" SIDE OUTLET CLOSET.

With Improved Flush (registered).



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No. 2. Plain—White, Ivory, or with Printed Pattern.

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Sole Maker—TWYFORD, Hanley, Staffordshire.

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JOHN HALL & CO.,

STOURBRIDGE.

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GOLD MEDAL—HEALTH EXHIBITION.

PURE WATER SUPPLIES.

"ABYSSINIAN" AND ARTESIAN TUBE WELLS.

NORTON'S Patent "ABYSSINIAN" and ARTESIAN TUBE WELLS, which were awarded the Gold Medal at the Health Exhibition, have been for many years in successful operation at the Burton Breweries of Messrs. Allsopp & Sons, Bass & Co., Truman, Hanbury & Buxton, and numerous other Breweries throughout the Kingdom. The Tube Well System has also been adopted for the Town Waterworks of Aldershot, Watford, Hertford, Shrewsbury, Skegness, Alnwick, Wallingford, St Albans, Abbott's Langley, Southwold, and Cirencester. Tube Wells can be sunk through rock, and have been made to a depth of over 800 feet.

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Contractors to H.M. War Department,

100, Bunhill Row, LONDON, E.C.

For the awards given by the Institute see Appendix, page 435.

H. TROTT'S

PATENT QUICK FILLING BIB & OTHER VALVES

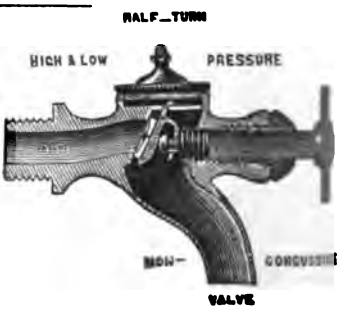
FOR HIGH AND LOW PRESSURE WATER,

Approved by the New River and other Water Companies,

PATENTEED IN ALL THE PRINCIPAL FOREIGN COUNTRIES.

Awarded a Certificate of Merit for Bib Valves for Hot or Cold Water, by the Sanitary Institute of Great Britain.

SEE TESTIMONIALS.



NOTICE.—These Patent Beaded Rubber Valves do not require the Screwing up like other valves.

DESCRIPTION.

These Patent Valves are strongly made, and consist of a sliding swinging valve in a chamber covered with a screwed cap, the unscrewing of which facilitates the removal of the inner valve, and the insertion of a new Patent Beaded Rubber when necessary, a work of the greatest simplicity and ease.

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2. They are quick filling.
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4. The beaded rubber is simply pressed against the flat metal Bevel seating, there being no metal cutting edge which destroy the rubbers.
5. These valves only require a slight half turn for closing, and DO NOT REQUIRE TO BE SCREWED UP LIKE OTHER VALVES.
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